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THE WISCONSIN NUMBER.

WE have previously issued special numbers of the Journal devoted to the Geography of Ohio (Mar. 1911), California (June, 1911), New York (March, 1912), and Canada (April, 1913). All of these seemed to meet with a hearty welcome and have been called for steadily.

The present issue is mainly the work of members of the Wisconsin Geographical Society which has been in existence two and a half years. The editor wishes to express his appreciation of the co-operation of the members of the Society who have contributed the articles. For a major part of the illustrations we are indebted to the State Geological and Natural History Survey and to the State Agricultural College.

We feel that, with the appearance of this special Wisconsin Number, the geography of the state is pretty thoroughly written up. Not only have we Professor Case's *Geography and Geology of Wisconsin* issued in 1907, Professor Merrill's *Industrial Geography of Wisconsin* (1911) and several excellent supplements to the school geographies, but the Bulletin of the American Geographical Society has recently published in several installments, (June to December, 1913) Miss Mary Dopp's extended paper on the Geography of Wisconsin, and the State Geological Survey has issued a 100-page cloth-bound bulletin on the Geography and Industries of the State.

Wisconsin should be one of the leaders in school geography. Every one of the eight normal schools has a strong, specially trained man in charge of the work in geography and the State University has a staff of seven men giving their full time to teaching the subject and two men giving part of their time. Five hundred students are enrolled in the geography courses.

What we now need is that this influence shall reach into every elementary and secondary school in the state, and we think it will.

THE PHYSICAL GEOGRAPHY OF WISCONSIN.*

By Lawrence Martin,
University of Wisconsin.

General Geography

WISCONSIN is larger than England and yet it contains only about one-fourteenth as many people, because of the more favorable position of England and its longer period of settlement, since the topography and climate are not dissimilar. England has greater mineral resources and trade advantages in relation to Europe and to the British Empire. But Wisconsin is only about half as large as Colorado, yet it supports nearly three times as many people. Wisconsin's general position may be somewhat more advantageous but Colorado's mineral wealth is far greater. This may be explained by topography and climate, for half of Colorado is too mountainous to support much population. The other half of Colorado is a high plain, with too dry a climate for agriculture without irrigation. Wisconsin is a series of plains. Relatively little of it is too hilly. Its climate is everywhere favorable to a successful agricultural industry. It will be advantageous to study the origin of the surface features of Wisconsin, for the capacity of this state for population depends chiefly upon topography and climate, and the limit will not be reached for many years.

Wisconsin is located a third of the way from the Atlantic to the Pacific Ocean, near the northern boundary of United States. It is in the Middle West, between Lake Superior, Lake Michigan, and the Mississippi River. Its greatest length is 380 miles, its greatest width about 290 miles, and its area is 56,040 square miles.

Geology. Wisconsin includes a large area of the oldest of rocks, the pre-Cambrian, and a still larger area of rocks of later, though very ancient, formation, the Paleozoic. There are also widespread, unconsolidated surface deposits made by the decay, or weathering, of older rocks, by stream and shore deposition, and by the continental ice sheet.

The lavas of northwestern Wisconsin and the granites of north central Wisconsin are igneous rocks, formed by the cooling of masses of molten material. The sandstone of central Wisconsin, (p. 268) the less common shale, and the limestones of the remainder of the state are sedimentary rocks. There are also metamorphic rocks made by the alteration of igneous and sedimentary rocks. The quartzites of the Baraboo Range and other parts of the state are metamorphic rocks derived from sandstone. Other metamorphic rocks are gneiss and schist. The pre-Cambrian area of northern Wisconsin,

*Partly from the author's forthcoming educational bulletin, *The Physical Geography of Wisconsin*, to be published by the Wisconsin Geological and Natural History Survey.

is entirely made up of these three and other sorts of metamorphic rocks and of large areas of igneous rocks. All these are crystalline rocks (map, p. 268).

Structures. Igneous rocks may be deposited originally in lava flows, as in northwestern Wisconsin, or in great underground masses, as the granites, which were later exposed at the surface by the removal of the overlying strata. Sedimentary rocks are originally flat-lying layers. Either one may be folded into arches and troughs or broken by faults or joints.

The metamorphic rocks which were originally sediments have been folded in the most complex manner and then erosion has cut off the folds. Thus we now have the remains of arches or anticlines, troughs or synclines, or faulted portions of either one, showing rock layers in every position from vertical to horizontal. On the other hand, the flat-lying sedimentary rocks of Wisconsin have merely been warped or arched into an extremely-broad fold, and the axis of the fold, which extends north and south, is inclined southward. Consequently the sedimentary rocks in central Wisconsin incline, or dip, southward, while those near Lake Michigan and near the Mississippi River, dip southeastward and southwestward respectively at a very low angle. This dip has been of vast importance in determining the topographic conditions in Wisconsin.

Processes. One process of modification is weathering, the crumbling of surface rocks under the influence of frost and the weather. Weathering breaks down the strongest rocks, so that streams, wind, waves, and glaciers erode and carry them away. The surface becomes mantled by the rock waste or soil, upon which our agricultural and dairy industry and our forests depend. Soil, subsoil, and weathered material mantle the surface of the earth, because weathering goes on rapidly there. Beneath the soil, however, there is always solid rock.

Underground water carries a load of dissolved material, partly from the weathered surface, and partly from deeper within the earth. The deposition of this dissolved material results in the formation of layers or veins of minerals in joint cracks and crevices, as in the lead and zinc deposits of southwestern Wisconsin. Some of the iron ores of northern Wisconsin have been enriched and modified by the work of the underground water, though the igneous and sedimentary rocks containing these ores had a large iron content originally. Plant and animal life also help modify the surface of the land.

Erosion, transportation, and deposition (a) by streams of running water, (b) by waves and currents in lakes, and (c) by glaciers are of most importance in the fashioning of the rocks of Wisconsin, with their various textures and structures, into the present surface forms.

Stages of Physiographic Development. The hills and valleys, the plains, the low plateaus, and the worn-down mountains of Wisconsin all represent stages in one or another of the several great periods of time, known as cycles, during which the processes listed above have been in operation. Thus north-

ern Wisconsin was in the old age stage of an early cycle when this cycle was interrupted by submergence beneath the sea. Likewise the region of weak sandstone in central Wisconsin advanced to the stage of maturity during the same time in which the more resistant limestones in the eastern, southern, and western parts of the state had only reached late youth. The accident of glaciation, however, interfered with this cycle of erosion, so that the northern and eastern parts of the state are now in a stage of extreme youth.

Geological History. The geological history of the state has involved periods (1) when all Wisconsin was mountainous, after the rocks of the pre-Cambrian were deposited and folded; (2) when all the state was a low featureless plain or peneplain; (3) when all of the state was submerged beneath the waters of the ocean and the sedimentary rocks of the Paleozoic were being deposited; (4) when this state was dry land and was being fashioned into something like its present form; (5) a Glacial Period, with all but the southwestern portion of the state buried beneath an ice sheet like those of Greenland and Antarctica, and (6) a brief post-glacial period. The Glacial Period was in the geological yesterday, perhaps only 35,000 to 50,000 years ago.

Topography

The larger part of the state lies between 700 or 800 feet in the south and 1600 or 1800 feet above sea level in the north. The highest point, 1940 feet, is Rib Hill, in Marathon County, near Wausau. The lowest elevation, 581 feet, is the eastern coast at the level of Lake Michigan. The Lake Superior coast, 602 feet, is nearly as low, as is the western border along the Mississippi River, from 685 feet at Lake St. Croix, near Prescott and Hudson, to 600 feet at the extreme southwest corner of the state, opposite Dubuque, Iowa.

Hydrography

Rivers. The largest river of the state is the Mississippi, on the western border. Its chief affluents are the St. Croix, Chippewa, Black, and Wisconsin Rivers, which unite directly, and the Rock River and the Fox River of southeastern Wisconsin, which flow through Illinois to the Mississippi. In the St. Lawrence drainage are the Fox-Wolf-Lake Winnebago system, the Menominee, on the northeastern boundary between Wisconsin and Michigan, and many small streams which flow directly into Green Bay, or Lake Michigan, or Lake Superior. Although smaller than the Mississippi, the Wisconsin River is really the master stream of the state. It rises in Lac Vieux Desert on the Michigan boundary and flows south through the center of the state for four-fifths of its length, before turning westward to the Mississippi.

Lakes. Except in the Driftless Area there are great numbers of lakes, of which the largest is Lake Winnebago. There are somewhat scattered, moderate-sized lakes in eastern and southeastern Wisconsin, including Mendota, Monona, Waubesa and Kegonsa—the four-lake group of the Yahara River, near Madison—and Lakes Koshkonong, Geneva, Beaver, Green, Puckaway,

Poygan, Shawano, and Butte des Morts, and the Oconomowoc and Waupaca groups. The lake districts of northern and northwestern Wisconsin, includes many hundreds of small lakes. Lastly, we have Lake St. Croix and Lake Pepin and the hundreds of very small floodplain lakes in the Mississippi bottom lands.

Coasts. The coast is exceptionally long, over 1,000 miles. Between half and a third of Wisconsin fronts on the water of Lakes Superior and Michigan. In Lake Michigan are the Door Peninsula, Green Bay, and Washington and adjacent islands. In Lake Superior the corresponding features are Bayfield Peninsula, the Bay of Ashland, and the Apostle Islands. There are practically no good natural harbors on Lake Michigan. The ports of Milwaukee, Racine, Kenosha, Sheboygan, Manitowoc, and Kewaunee, as well as Green Bay and Marinette on Green Bay, are merely improved mouths of rivers. The harbors of Superior and Ashland on Lake Superior are much better, lying behind sand spits. The depth of water in Green Bay is from 50 to 120 feet; in the Wisconsin portion of Lake Michigan it is from 280 to 870 feet. As the boundary between Wisconsin and Michigan is in the middle of the lake, whose surface is 581 feet above sea level, this means that part of the submerged eastern portion of the state is 300 feet below the level of the ocean. In Wisconsin, the deepest part of the bottom of western Lake Superior is about at sea level.

PLACE OF WISCONSIN IN PHYSICAL GEOGRAPHY OF UNITED STATES.

On the basis of various geographical features, especially geology, topography, climate, etc., it is customary to divide United States into natural regions or physiographic provinces. The state of Wisconsin lies in two of these provinces,—the Lake Superior Highlands and the Prairie Plains. According to less common usage it extends within a third province, the Lake Shore Plains.

GEOGRAPHICAL PROVINCES OF WISCONSIN

The Northern Highland. This largest of the geographical provinces (Fig. 1) is an upland plain worn down to low relief on the site of ancient lofty mountains, as is shown by the rock structures there. Above it rise residual knobs of resistant rock—monadnocks—such as Rib Hill and the Penokee Range. Since it was worn down to low relief the Northern Highland has been (a) lowered beneath the sea, (b) buried beneath the ancient Paleozoic sandstone, (c) uplifted and warped, (d) partly exhumed, and (e) in much of the area, modified by glaciation. Through the warping of the highland its present altitude varies from 1000 to 1650 feet. Valleys have been cut 200 to 300 feet into the highland, but its buried extension, which underlies the whole state, is revealed only (a) where strips are revealed along valleys, as at Black River Falls, (b) where the tops of former monadnocks are exposed, as at the Baraboo Range and near Waterloo, and (c) where deep wells reach it, as at Madison, 818 feet below the present surface or 85 feet above sea level, at Brodhead, 1030 feet below the present surface or

230 feet below sea level, and at Platteville, 1718 feet below the present surface or 818 feet below sea level.

At the borders of the Northern Highland outliers of sandstone rest on the old peneplain surface, forming low mounds.

The areas of latest drift, of older drift, and of driftless topography in the Northern Highland differ notably in topography, soil, and drainage, some of the drift being 50 to 600 feet thick. The lake district of northern Wis-

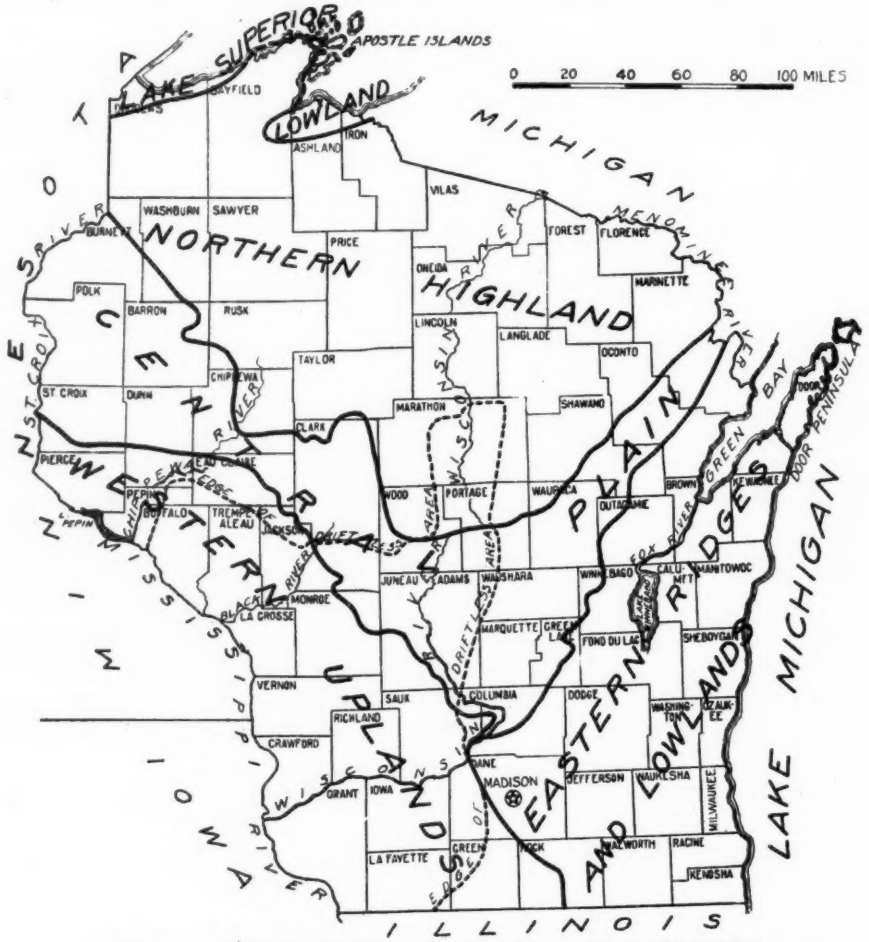


FIG. 1. GEOGRAPHICAL PROVINCES OF WISCONSIN.

consin is one of the most wonderful in the world, the small lakes in Vilas County covering about 40 per cent of its area. At the southern border of this province is a Fall Line, where cascades and rapids in the rivers furnished the original basis of the lumber manufacturing industry of such places as Grand Rapids, Stevens Point, and Chippewa Falls.

The Lake Superior Lowland. This small geographical province (Fig. 1) within which Superior and Ashland are situated, lies near the level of

Lake Superior in a rift valley, bordered by high escarpments. It was produced by down-faulting of a block of the earth's crust, and subsequently deepened and then partly filled again during the Glacial Period.

The Central Plain. The central part of Wisconsin (Fig. 1) is a plain of low relief in the area of early Paleozoic sandstone. Its eastern and northwestern portions have been greatly modified by glacial deposition. Among these deposits is a large glacial outwash plain, extending from Stevens Point southward to Baraboo. Among the streams diverted from pre-glacial courses is the Wisconsin River, which has a beautiful series of post-glacial gorges at the Dalles near Kilbourne. Above the southern border of the Central Plain rises the Baraboo Range, an exhumed monadnock of the buried pre-Cambrian peneplain. Across this range extends the abandoned gorge of the Wisconsin River. Inside this gorge lies Devils Lake, held in by morainic deposits. Numerous, flat-topped, castellated mesas and buttes rise above the level of the plain in the Driftless Area, as at Camp Douglas.

The Eastern Ridges and Lowlands. In the Eastern Ridges and Lowlands the rocks dip more steeply than in the Western Uplands, though the rock texture—chiefly limestone—is almost identical. Erosion has carved the eastern limestones into a series of three unsymmetrical ridges, or cuestas, with bold escarpments facing the northwest and gentle dip slopes inclined toward the east or southeast. Between two of these cuestas is the Green Bay-Lake Winnebago-Fox River lowland.

Here a process not operative in most of the Western Upland, glaciation, has modified the topography, especially by depositing (a) rolling ground moraine plains, (b) oval drumlins, (c) irregular terminal moraines, and (d) small areas of outwash gravels and lake clay plains. It also modified the cuestas by glacial erosion and by scouring out the deep basin of Lake Michigan along a pre-glacial river valley. At its borders are abandoned beaches of the Glacial Great Lakes. Glacial diversion of drainage is responsible for the water power of the Fox River, especially at and below Lake Winnebago, where the power initiated the manufacturing industry of this great industrial portion of the state.

The Western Uplands. The western uplands differ as to (a) structure —the dip being much flatter in the greater part of the highland—and (b) process—glaciation not having followed the pre-glacial weathering and stream erosion, except in the regions west of Janesville and northwest of the Chippewa River, the rest of the Western Uplands being in the Driftless Area.

The Western Uplands form a rather-low, much-dissected plateau. The valleys range in size from the large Mississippi to the Wisconsin, Black, and Chippewa and still smaller streams. The valley forms vary with the proportions of sandstone and limestone in their walls. Practically no flat-topped upland is left, but the interstream areas in the southern, younger limestone area are wider than those in the middle and northern older limestone, and these are wider than in the areas where the whole upland is sandstone. The

portion of the Western Uplands south of the Wisconsin River is higher than that to the north, its most elevated portion being called the Military Ridge. There is no conclusive evidence that a peneplain ever existed on the Western Uplands, the isolated limestone knobs like Blue Mound—1720 feet—being best interpreted as outliers left by the stripping off of a still younger limestone which forms a higher plateau to the southwest in Iowa.

The gorge or trench of the Mississippi narrows southward with relation to resistant limestones, as does the Wisconsin River. In the Mississippi trench, which was even deeper before the Glacial Period, are glacial valley train deposits and a modern floodplain. Lake Pepin is due to the damming of the Mississippi by the Chippewa, and Lake St. Croix to the blocking of the St. Croix River by Mississippi River deposits. Whether Lake Pepin is a broad stretch of river or a true lake must be settled before this portion of the Wisconsin-Minnesota boundary is permanently determined. The scenery of the Mississippi valley in western Wisconsin, where the gorge walls rise over 650 feet, is not inferior to that of the gorge of the Rhine in Germany, though not yet well known to travellers in America.

THE CLIMATE OF WISCONSIN

By F. E. Williams, University of Wisconsin, Madison.

General

THE climate of any region is dependent mainly on latitude, distance and direction from large bodies of water, altitude, and weather conditions. Since Wisconsin is in a rather high latitude and is far distant from any very large body of water, it has a climate subject to great seasonal changes, or a climate known as "continental." This continental climate is much influenced by the cyclonic storms which move eastward across the state, and by the storms which move up the Mississippi Valley; moreover, the climate of the eastern and northern parts of the state is modified slightly by Lakes Michigan and Superior. In general it may be said that the winters are long and severe, the summers short and warm, but that the relative dryness and uniformity of weather conditions make living in Wisconsin much more pleasant than in the northeastern states having about the same latitude, and, in some cases, having less extreme temperatures.

Temperature

The mean annual temperature for the state is 43.3°, varying from 48° in the southwest corner of the state to 39° in the northeastern portion. There is, of course, a decrease in temperature from south to north due to the influence of latitude. There is a more rapid decrease in the northern portion of the state dependent on the increasing elevation. Thus the lowest mean annual temperature is found in the northeastern part of the state rather than at lower elevations on the extreme northern boundary.

The influence of altitude is also quite marked in the southwestern part

of the state where the temperature is lower than in the valley of the Wisconsin River which lies a little farther north.

The influence of the Great Lakes over small areas adjacent to them is striking; while the mean annual temperature of these areas adjacent to the lakes is not markedly different from the other portions of the state, yet the range of temperature is considerably less. In general, the lake shores are about 4° cooler in summer and 4° warmer in winter than inland points of the state. The distance to which this modifying influence may be felt varies

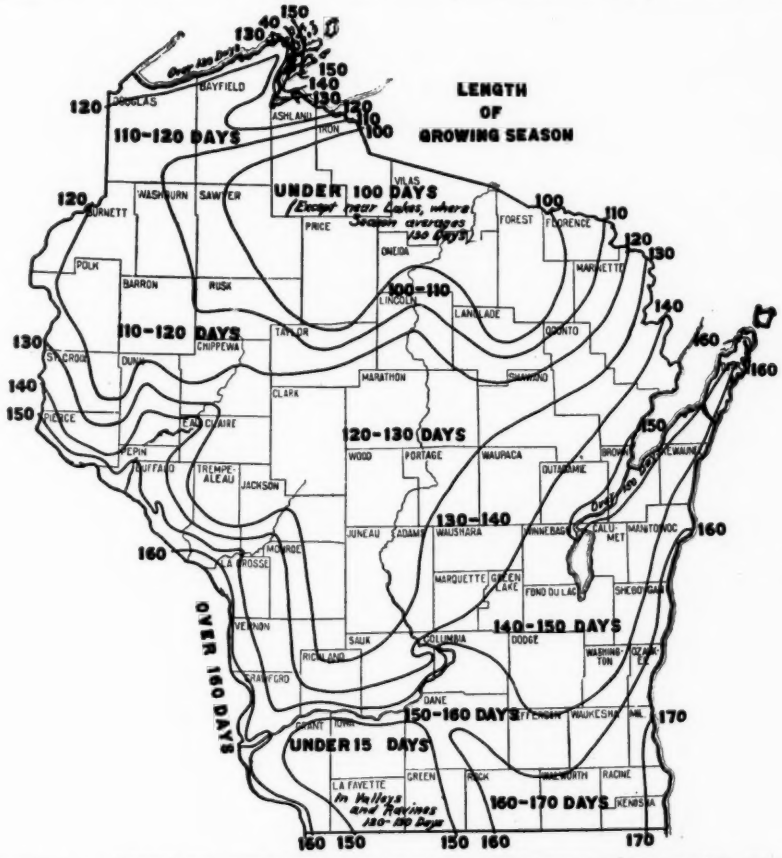


FIGURE 1. AVERAGE NUMBER OF DAYS BETWEEN THE LAST KILLING FROST IN THE SPRING AND THE FIRST IN THE FALL.

with location and wind direction, but is usually only a few miles. The regions around Bayfield and Ashland, and the Door Peninsula, are the most favored by the modifying lake breezes.

The influence of Lake Michigan is shown by contrasting the recorded temperatures taken at the lake shore and at inland points. Milwaukee has one of the highest recorded temperatures on the Lake Michigan shore, 100.3°, and Green Bay has one of the lowest,—36°. Harvey in Jefferson County, and Lancaster in the southwestern part of the state, have recorded 107°

while Stevens Point and Barron have records as low as—48°. Neillsville, situated at some distance from the lakes, has an absolute range of 146° while Oconto on the shore of Green Bay has an absolute range of 120°.

Precipitation

The rainfall is derived almost entirely from the cyclonic storms which pass across the state at irregular intervals but the distribution over the state is remarkably uniform. There are over eighty stations in the state where records are kept and all but four of these show an average yearly rainfall of 28 to 34 inches, while the mean for the whole state is about 31 inches. Wisconsin has a total rainfall about equal to that of eastern Oklahoma and Kansas, northern Iowa, Michigan, and northwestern New York. The rainfall is more effective in Wisconsin than in most of the above named places because of the smaller evaporation in a more northern latitude.

The heaviest rainfall, an average of 34 inches, occurs on the Western Uplands and to a somewhat less extent on the Northern Highland, a considerable part of which falls in the winter months in the form of snow. The regions around Lake Winnebago and along the Superior shore receive the lightest rainfall, an average of 29 inches; this is due to their position in the lee of higher lands.

Since the movement of cyclonic storms is irregular, both in interval and in the paths taken, the local distribution of rainfall varies greatly from year to year, first one section receiving more and then another. The average precipitation for 1910 for the whole state was 21.4 inches, the driest year Wisconsin has had since records have been kept. In 1911 the average rainfall for the state was 37 inches. The rainfall for 1910 and 1911 shows that the precipitation may vary considerably in different years as well as for different localities. The northwestern part of the state has the greatest extremes in precipitation, ranging from 15 inches in the driest years to 45 inches in the wettest. The eastern part of the state near Lake Michigan has a much smaller variation, from 20 inches in the driest year to 40 inches in the wettest.

Relation to Crops

The mean annual temperature and the average yearly rainfall are important in agriculture but the length of the growing season and the seasonal distribution of precipitation must be taken into account when contemplating the cultivation of any crop. Figure 1 shows the length of the growing season in different portions of the state. The sun shines, on the average, about half of the possible time during the year, the greater percentage of the sunny days being in the summer season. The regions in the southeastern and extreme southwestern parts of the state and those around Bayfield and the Door Peninsula are most favored in regard to the length of the frostless period. Wisconsin is especially favored in its seasonal distribution of rainfall, since nearly 70 per cent comes in the growing season, or from April to September.

THE LUMBERING AND WOOD-WORKING INDUSTRIES

By C. F. Watson, Normal School, Stevens Point.

FEW states have been so richly endowed with timber as Wisconsin, and in few states have the lumbering and wood-working industries played so important a part in the industrial life of the people. When the early French traders and trappers first paddled their canoes silently down the rivers of Wisconsin, they found the greater part of the land covered with magnificent forests. Over one hundred billion board feet of white pine studded the banks of its rivers and intervening uplands. The area originally covered with merchantable timber was so great that the forests ranked second only to the soil as a natural resource. When the lumbering industry was at its height, the value of the output of the mills was almost $70,000,000 annually. This exceeded the average annual gold output for the whole United States.

Although the greater part of the state was originally under forest, lumbering has been the dominant industry only in the northern half. Saw timber of economic value was confined largely to that portion lying north of an irregular line running from the shores of Lake Michigan, near Milwaukee, in a broad curve northwestward past the southern end of Lake Winnebago, across southern Portage county and the Wisconsin River to the St. Croix River near its falls. North of this line, lie forty-five counties and parts of counties, with an area of approximately 18,700,000 acres, almost all of which carried heavy growths of pine or mixed forests. Over thirty per cent of this area was under some species of conifer, and even in the mixed forests, pine formed a conspicuous part. Jack pine, white pine, Norway pine, hemlock, oak, spruce, maple, birch, basswood, elm, and tamarack made up the greater part of the mixed forests. White pine, the most valuable tree of all our northern woods, was to be found in almost every township, and from its lofty trunks has been secured the bulk of the lumber which has gone into the buildings not only of the 2,333,000 citizens of Wisconsin, but also, in a large measure, into the fences, barns, and dwellings of the inhabitants of the prairie states from Indiana to the western plains of Kansas.

The "pineries" of Wisconsin belong to that belt of forest which originally covered northern New England, New York, southern Canada, Michigan, and the greater part of Minnesota, with an extension southward along the Appalachian Highland to Georgia. So great was this white pine area and so dense the forest that from it has been obtained the main timber supply of the nation until quite recent years. The drain upon this resource, however, together with the wasteful methods of lumbering employed, have proven so great that what might have been made a permanent source of supply of the finest lumber, is now rapidly approaching exhaustion.

The center of the lumbering industry, which was originally located in New England, slowly shifted westward through this forest belt until now there are only very small areas which have not been cut over. It moved

gradually toward the lake region as the people of the Atlantic States crossed the Appalachian Highlands and began to settle the upper Mississippi Valley. Much of this region, being prairie, was devoid of timber suitable for building

FIGURE 1. SCENE IN ONE OF THE FORESTS OF NORTHERN WISCONSIN NORTH OF CHIPPEWA FALLS.
These forests have yielded far more wealth than the gold mines of California.

purposes, and as the settlers became more and more numerous the demand upon this, the most accessible forest, grew ever greater. The Mississippi and the Great Lakes, with the tributaries which flow into them, afforded com-

paratively easy lines of approach to what appeared an almost unlimited supply of lumber.

History

Even before Wisconsin Territory became a state, scores of saw mills were already located along the banks of its numerous streams. Hundreds of men were busy each winter cutting and hauling the logs, and piling them on the banks of the rivers down which they were to be floated to the mills on the high water of the spring freshets. The state was particularly fortunate in having its forest area drained by no less than seven large rivers upon which log driving could be carried on. As a result of the favorable drainage, well defined lumbering districts developed in the following regions: (1) on the shores of Green Bay, (2) on the Wolf River, (3) on the banks of the Wisconsin, (4) along the Black River, (5) in the valleys of the Chippewa and Red Cedar Rivers, and (6) on the Wisconsin branch of the St. Croix.

The first saw mill built in the state was put up in the Green Bay district near De Pere in 1809. Important lumbering operations did not begin here, however, until 1834. The next year witnessed the opening up of the Wolf River district. The building of Fort Winnebago (Portage) in 1826 and of Fort Crawford (Prairie du Chien) three years later indicates the time when logging began on the Wisconsin. A mill was built on Black River as early as 1819, but, owing to Indian troubles, lumbering did not gain a permanent foothold there until 1839. The aborigines also interfered in the Chippewa district, and it was not until 1826 that a successful mill was finally established on the present site of Menomonie. This, in brief, is the history of the beginning of the industry.

Progress was slow at first and the annual value of the output did not reach $1,250,000 until 1850. After the close of the Civil War, however, the growth became much more rapid. The following table, which gives the annual value of the total cut of *rough lumber* for the different census years, shows how great the development has been.

1850 about.....	$ 1,250,000	1890 about.....	$61,000,000
1860 about.....	4,500,000	1900 about.....	58,000,000
1870 about.....	15,000,000	1905 about.....	44,000,000
1880 about.....	18,000,000	1910 about.....	30,000,000

So rapid was the expansion of the industry, that, by 1900, Wisconsin had not only overtaken, but had passed every other state in the union in total production. Over a thousand mills were in operation, and in that year they cut 3,361,943,000 feet of lumber. One mill at Chippewa Falls, alone, cut 65,000,000 board feet. The capital invested in the saw milling industry amounted to $100,000,000, a sum equal to one-third of the assessed value of all the land in the state.

Conditions Which Influenced the Development of the Industry

The marvelous growth which took place in the manufacture of lumber in

Wisconsin was due in a large measure to geographic conditions. The situation, surface, drainage, and climate were all decidedly in its favor. The long cold winters with plenty of snow made it possible to cut the logs and haul them out to the banks of the streams with the smallest amount of labor and expense, and the melting of snows made it comparatively easy to float them to the mills on the high waters of the spring freshets.

The influences exerted by the favorable surface and drainage conditions have been no less marked than those of climate. The whole area may be described as a plain, nearly all of which slopes gently toward the south, south-

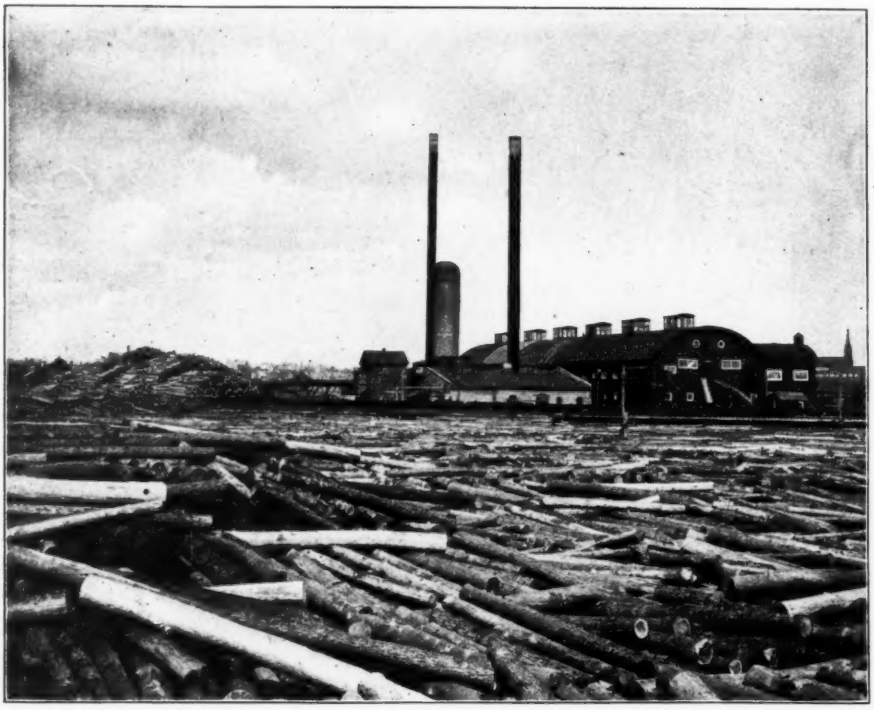


FIG. 2. MILL OF THE NORTHWESTERN LUMBER COMPANY AT STANLEY, IN NORTHERN WISCONSIN.

west, and southeast; and few sections are irregular enough to seriously interfere with the building of transportation lines. The slope of the surface has directed the flow of the rivers southward into the prairies, and the Wisconsin streams were largely used to supplement the work of the railroads as transportation agents. Billions of feet of logs have been floated down these streams far beyond the boundary of the state. The United States Census reports 500,000,000 feet of logs as having been rafted down the Mississippi to points in Iowa, Illinois, and Missouri in 1880.

Of all the geographic conditions that have affected the development of the lumber industry in Wisconsin, the location has, without doubt, been the most important. The close proximity of the "pineries" to the broad prairies

of southern Wisconsin, Illinois, Iowa, and Missouri, and to the Great Plains farther west, made the state for many years the principal source of lumber supply for these regions. This was particularly true after the railroads were built into these states. Bleak, open stretches of country were unfamiliar to the early pioneer who had come from a more or less densely wooded country farther east. The distance from timber and running water made them unattractive to him, and it was not until the coming of the railroads that these prairies began actively to be settled. The railroad companies started to build westward from Chicago and the lake region about 1850, and so rapid was the progress made, that in the next few decades nearly all sections of not only the prairie states but the states of the Great Plains, were supplied with transportation by rail. The settlers of these regions were now able to secure lumber

FIG. 3. ROLLWAYS OF THE WISCONSIN RIVER NEAR TOMAHAWK, LINCOLN COUNTY.

for building purposes at prices within the reach of all. The experience of Peoria, Illinois, illustrates the conditions that prevailed generally throughout the area. In 1838 pine lumber sold in Peoria for $60 to $70 per M., but when the railroad reached that point from Chicago, prices dropped more than one-half. If the following table, which shows the increased railroad mileage in the several states from 1860 to 1910, be compared with the census table showing the annual value of the lumber output from 1850 to 1910, it will be noted that the years of greatest activity in railroad building coincide exactly with the years of most rapid growth in the lumber business in Wisconsin.

Railroad Mileage in Different Census Years.

	1860	1870	1880	1890	1900	1910
Illinois	2790	4823	7851	10214	11003	11879
Iowa	655	2683	5400	8356	9185	9754
Kansas		1501	3400	8806	8719	9007
Wisconsin	905	1525	3155	5583	6530	7475
Missouri	817	2000	3965	6004	8875	8082

THE EVOLUTION OF THE INDUSTRY

A change no less marked than the rapid growth of the industry, has taken place in the character of the output of the mills. White pine lumber, which originally made up the bulk of the product, has now given place to hemlock. The supply of white pine has become so diminished that hemlock, once considered almost valueless, is now being cut in a large quantity. This tree has come to have a variety of uses. The trunks are used not only for lumber, but also for the manufacture of wood-pulp and paper; and its bark was until recently the main reliance of the tanning industry.

With the gradual exhaustion of white pine has come the utilization of the many different kinds of hard woods that are found extensively over the forest area. Mills that formerly cut only pine are now engaged in the production of oak, maple, birch, basswood, elm and several other kinds of hardwood lumber. Many mill owners have been forced to enlarge their plants. They have added equipment for making planing-mill products, sash and doors, boxes and other shaped lumber, in order to keep their mills running, and to utilize materials that formerly went to waste. Not all mill owners were able to do this. Some of them were forced to dismantle their plants; others moved away to regions where the industry is now more profitable; still others, who were not in a position to dispose of their property advantageously, began to direct their attention to the development of the various other wood-working industries. In this line of manufacturing they were able to make use of the vast amount of experience which they had accumulated in the lumber business, and it is therefore natural that they should first turn their attention to this phase of the work.

The extent to which wood-working has developed is indicated in a recent publication of the State Board of Forestry. An investigation carried on by that body revealed the fact that there are twenty-one different classes of wood-using industries operating in Wisconsin with an annual consumption of over 930,000,000 board feet. This amount is equal to about one-half of the annual output of rough lumber for the state. About forty-nine per cent of the raw material for these industries is shipped in from other states and from foreign countries. Over forty different kinds of woods are utilized. Of this class of manufactures, the paper and wood-pulp interests are the most extensive. The value of the output of this industry amounted to $25,963,000 in 1909, an increase of 45.5 per cent in five years. Wisconsin ranked third in the manufacture of wood-pulp in that year. The products of the furni-

ture and refrigerator factories in 1909 amounted to $18,656,000, an increase of 50.8 per cent over 1904. The same rapid growth that characterized these industries prevailed in many of the other lines of wood-working. Thus it appears that despite the fact that logging is decreasing in the state, the wood-using industries are increasing. The rapid rise of this phase of manufacturing adds still further to the constantly growing demand for lumber.

The Future

The problem of the future supply is becoming more and more acute each year. Despite the soaring prices of lumber, the state's production has fallen off almost one-half since 1900. To make the situation still more critical hundreds of thousands of acres are constantly being destroyed by fire. In 1908 alone, 1,200,000 acres were burned over, with an estimated loss of about $9,000,000. This is only one of the many ways in which the timber resources of Wisconsin are being needlessly wasted.

Fortunately, the people of the state have at last awakened to the necessity of the conservation of their forests. The state has already acquired over 400,000 acres of cut-over land for the purpose of reforestation. A system of forest patrol has been put into operation in this area, and will be extended as rapidly as more land is purchased. A State Board of Forestry has been organized whose duty it is to outline and put in execution a vigorous system of forestry. It is estimated that 45 per cent of the area of Wisconsin is still wooded. With this area under scientific management the question of a future lumber supply will become less serious.

DAIRYING IN WISCONSIN

By Edward G. Lange, Normal School, Whitewater.

WE, of the Badger State, are justly proud to know that Wisconsin has become the leader among the states in the dairy industry. Of all marked developments in the broad field of agricultural activity none has kept pace with the recent progress in dairying. The gentle-eyed cow has indeed become the queen of domestic animals within our fair domain. Let us consider briefly a few facts and conditions attending the history and growth of this great industry and seek reasons for its splendid development.

Mr. Ellsworth Huntington in his valuable book, *The Pulse of Asia,* has developed the importance of the geographic basis in the study of the anthropological sciences. He has insisted at the outset, however, that, "in the progress of human knowledge the marked advances in each science have been made under the stimulus of great fundamental principles acting as causes in the development of human activities." Mr. R. H. Whitbeck, in his recent bulletin on *The Geography and Industries of Wisconsin* has emphasized a similar principle showing that modern industries which are extensively carried on in any region are dependent, to a considerable degree at least, upon climate, natural resources, topography and situation, coupled with the stage

of development of the region in which they exist. He states later in his bulletin, however, that "The great prosperity and rapid development of the dairy industry of Wisconsin cannot be explained alone on the basis of geographic causes." He apparently would agree with Mr. Huntington's idea that "physical processes do not explain all qualities of man,—his life, mind, ideas, etc., which move mankind." Apparently then, an attempt to sift out specific causes which have been responsible for the development of any great industry involves factors of considerable complexity,—enthusiasm, aims, ideals, personality, determination, faith. The Wisconsin idea and spirit certainly are not easily measured or defined by a mere array of words.

FIGURE 1. RELATION OF CHEESE DISTRICTS AND GROWING SEASON. Cheese production has developed in those portions of the state having less than 150 days in the growing season.

Wisconsin became a state in 1848, the thirtieth state of the Union, and now ranks twenty-fourth in area and thirteenth in population (1910).

The Wisconsin Dairyman's Association, the first great social factor in the development of the dairy industry in our state, was organized in 1871. It has held forty-two annual meetings and has been a most active force from the beginning. The immediate necessity which prompted the organization of

this association, and which first engaged its attention, was the lack of transportation facilities, although a number of equally important aims were in view from the start. At this time Wisconsin had forty cheese factories, no creameries, and the annual income from all dairy products was about one million dollars. In 1910 there were 1928 cheese factories, 1005 creameries and 19 condenseries in operation, the product of these in 1913 will pass the $85,000,000 mark. Considering that the northern two-thirds of the state has less than twenty-five per cent of its area in farm lands today, and also that it is a natural grass and fodder producing region, one can see a great future for the dairy industry during the next forty years.

The following facts and figures have been gleaned and borrowed from various sources. The first nine have been taken from Mr. R. H. Whitbeck's recent bulletin on Wisconsin Industries, and the rest from bulletins issued by the Agricultural Department of the University of Wisconsin, Reports of Wisconsin's Dairy and Food Commissions, Buttermakers' Association, Cheese Makers' Association, and U. S. Census Reports. The maps and views are also from these sources.

There are as yet relatively few factories or creameries in the northern part of the state, due to undeveloped agricultural conditions.

Cheese factories and creameries are few in seven counties in the central portion of the state—largely due to the sandy character of the soil, unfavorable in pasturage.

Practically all of the 3,000 cheese factories and creameries are in the region of clay soils whose water-retaining capacity favors pastures and meadows.

The creameries are most numerous in the corn belt; butter-making is a response to winter as well as to summer dairying; corn, in the form of ensilage, is economical winter feed for cows; the corn belt closely coincides with the region of 150-day growing season, (see map) and in this belt cheese factories seem unable to meet the competition of butter factories.

The cheese factories almost monopolize a region near Lake Michigan and another in the rougher and higher lands of the southwest; for cheese-making is a response to summer dairying, prospers where weather, especially the nights, are cool, and hence where corn growing is less important.

Wisconsin leads in the making of Swiss cheese, chiefly carried on in the Swiss settlements in the southern part of the state. This cheese is more sensitive to soil and climatic conditions than any other kind; the Swiss factories are nearly all on land 900 to 1000 feet in altitude, and 95 per cent of the 275 factories are on limestone land, while 70 per cent of the 106 factories making Limburger cheese are grouped in the low valleys on sandstone land.

Northern Wisconsin, with its clay soil and cool climate, promises to develop into another great cheese-making section.

The trend toward dairy farming is most beneficial to the agricultural interests of the state.

About 60 per cent of the land area of the state is in farms. Nearly all of the southeastern third is improved; but eleven counties in the northern part of the state had, in 1910, only about one-tenth of their land in farms. (Florence, Forest, Vilas, Iron and Sawyer counties had less than ten per cent). About 36 per cent of the land area of the state is improved farm land, and the farm property is valued at over one and a half billion dollars.

At present a lack of corn and hay in the northern part of the state is largely the result of the large undeveloped area but, nevertheless, shows the

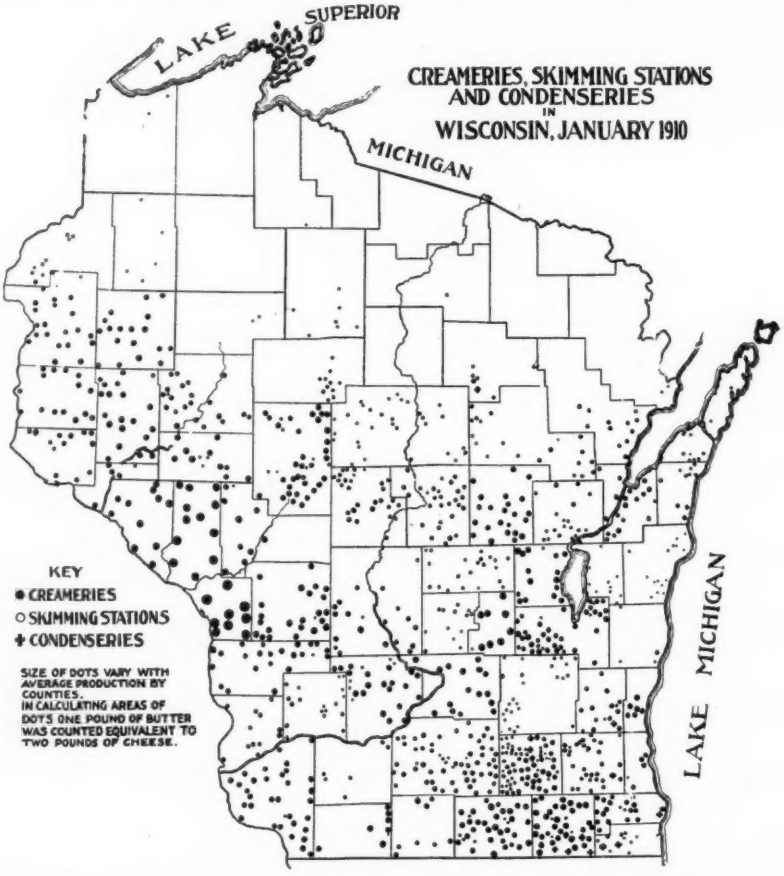

LAKE SUPERIOR
CREAMERIES, SKIMMING STATIONS AND CONDENSERIES IN WISCONSIN, JANUARY 1910
MICHIGAN
KEY
● CREAMERIES
○ SKIMMING STATIONS
+ CONDENSERIES
SIZE OF DOTS VARY WITH AVERAGE PRODUCTION BY COUNTIES. IN CALCULATING AREAS OF DOTS ONE POUND OF BUTTER WAS COUNTED EQUIVALENT TO TWO POUNDS OF CHEESE.
LAKE MICHIGAN

FIGURE 2. CREAMERIES, SKIMMING STATIONS, AND CONDENSERIES. This shows their concentration in the corn producing sections of Wisconsin in 1909.

lack of the feed basis for dairying. Since the growing season for grasses is much longer than for corn it should be kept in mind that the hay crop in the north has not the same limitations as corn for seed. Anyone who has ever roamed the northern counties in pursuit of fish and deer, knows that no part of our state can show a more luxuriant development of native grasses and clover than our northern counties.

The development of factories is extending towards the north and northeast. The absence of factories in Jackson, Wood, Juneau, Adams counties can be explained by the absence of hay and corn and these by the lack of improved land, much of this region being sandy and swampy.

Although the number of creameries and cheese factories has decreased in certain sections during the past five years, it does not follow that the total production of milk in such sections has decreased markedly. For example in Walworth County where creameries decreased 73 per cent in number, the decrease in pounds of butter manufactured was only about one-half of one per cent. In Dane County, where the number of creameries decreased the production of butter was greater than before.

Fifteen counties out of seventy-one, however, show a decrease in the production of butter manufactured during the last five years. The greatest

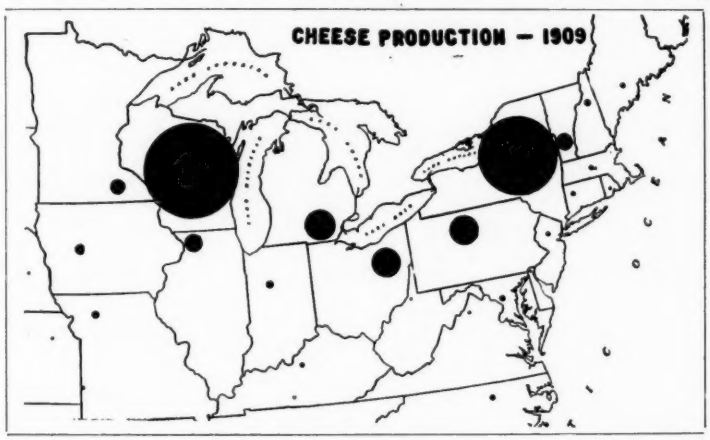


FIG. 3. MAP SHOWING THE RELATIVE PRODUCTION OF CHEESE IN THE PRINCIPAL DAIRYING STATES.

decrease being in Dodge County where a reduction of one-half took place, Jefferson and Kenosha showed a slight decrease in butter production, owing to a greater sale of milk and cream to cities and condenseries. There was a marked increase in the production of butter in Barron, Dunn, Grant, Vernon, Columbia and Wood counties, and a great gain in the northern part of the state as a whole.

During the decade from 1900 to 1910, there was an increase of 47.4 per cent in the number of cows in Wisconsin, total, 1910—1,471,591 head. It is fair to state that this figure now passes the 1,600,000 mark. (In 1911 New York had 36,089 more cows than Wisconsin, she is today our close rival in the dairy industry.) During the same decade there was an increase of 70.4 per cent in the production of butter—amounting to 105,307,357 pounds (factory product only;) an increase of 86.7 per cent in cheese production (factory product only) 145,171,035 pounds produced in 1910.

From 1900-1910 there was an increase in the number of cows in every county of the state except Milwaukee County.

In the western section of the state cattle raising is followed more largely for beef production, while in the eastern and southern parts for dairy purposes.

The leading dairy breeds in Wisconsin are Guernsey, Holstein, Jersey, Brown Swiss, and Ayrshire. The leading beef breeds are Short Horn, Polled Angus, and Herefords, some of above being dual purpose animals.

Jefferson County leads the state in butter production, and Sheboygan and Green counties lead in production of cheese.

In 1900 there were 260 skimming stations in Wisconsin, in 1910 there were only 88. The introduction of the hand separator on the farm accounts for this. The separator has also increased the size of the area tributary to each creamery and thus produced creameries with larger output of butter.

In 1910 there were 1005 creameries, 1928 cheese factories, 88 skimming stations and 19 condenseries in the state. (There are probably over 25 condenseries in the state at present using close to 250,000,000 pounds of milk annually).

Statistics from the 1911 *Yearbook*, U. S. Dep't. of Agriculture, show that Wisconsin creameries received 1⅓ cents a pound more during the year than did patrons of Minnesota creameries, 2¼ cents a pound more than did patrons of Michigan creameries; 2½ cents a pound more than did patrons of the creameries of Iowa and Illinois. In this connection it is worth noting that a loss of one cent per pound on butter will reduce the net income of the state over $1,000,000 annually.

In 1890 the report of the dairy and food commissioner of Wisconsin showed that, "our business of making cheese was most falsely manipulated, and that no article of food has been so degraded by counterfeiters." (Wisconsin produced sixty million pounds of cheese in that year). "Cheese was filled and otherwise adulterated." By persistent and earnest endeavor the Wisconsin Dairy and Food Commissioner and his assistants have succeeded in raising the standard of dairy articles in this state until the following facts are true:

In 1909, at the National Dairy Show, in Milwaukee, Wisconsin cheese won first, second and third premiums in *all* classes exhibited.

In 1910, at the National Dairy Show in Chicago, Wisconsin cheese won first, second and third premiums in all classes exhibited.

In 1911, at the National Dairy Show in Chicago, Wisconsin cheese won first and second; Wisconsin Swiss cheese won first, second, and third; and Wisconsin Brick cheese won first and second.

In 1911, at the International Dairy Show in Milwaukee, Wisconsin cheese won first, second, and third premiums in all classes exhibited.

Wisconsin is now producing in great variety, and in quality unexcelled anywhere, upwards of 164,000,000 pounds of cheese annually for which including by-products, the producers are receiving over $24,000,000.

The United States Census reports for 1910 give the following regarding the production of farm and factory butter for the year of 1909:

Total Production for Entire United States: 1,619,415,263 lbs.

Wisconsin	131,085,193 lbs.	Ohio	81,060,383 lbs.
Iowa	127,261,755 lbs.	Illinois	71,180,968 lbs.
Minnesota	123,551,575 lbs.	New York	69,358,918 lbs.
Pennsylvania	91,642,332 lbs.	Texas	67,126,804 lbs.
Michigan	85,917,186 lbs.	Indiana	54,894,267 lbs.

Production of farm and factory cheese for year of 1909 as follows:

Total Production for Entire U. S.—320,532,181 lbs.

Wisconsin	148,906,910 lbs.	Illinois	4,881,153 lbs.
New York	105,584,947 lbs.	Oregon	4,388,158 lbs.
Michigan	13,673,336 lbs.	California	4,345,513 lbs.
Pennsylvania	12,676,713 lbs.	Vermont	3,008,540 lbs.
Ohio	12,473,834 lbs.	Minnesota	2,841,958 lbs.

Increase in Population of U. S., 1890-1910, 62,622,256 to 91,972,266, a gain of 46.7 per cent.

Production of Butter in U. S., 1890.....1,205,508,384 lbs.
Production of Butter in U. S., 1910.....1,619,415,263 lbs.
Increase in Amount of Butter produced .....34.3 per cent
Production of cheese in U. S., 1890.....256,761,888 lbs.
Production of cheese in U. S., 1910.....320,532,181 lbs.
Increase in amount of cheese produced.....24.8 per cent

The conclusion is evident.

Table showing Increase in Value of Dairy Products of Wisconsin 1890-1910.

1890	$21,280,000	1905	$68,407,000
1895	36,434,000	1910	79,000,000
1900	40,400,000	1915	What will it be?

From the above figures it is evident that Wisconsin produced nearly one half the cheese (46.4 per cent) of the entire United States in 1909. From 1899 to 1909, cheese production in Wisconsin increased 87.6 per cent, while outside of Wisconsin, the production of cheese in the United States decreased 21.6 per cent.

Four kinds of cheese are manufactured in important quantities in Wisconsin, namely, Cheddar (commonly called American), Swiss, Brick, and Limburger. Cheddar constitutes nearly two-thirds of the total cheese production of the State. Practically all the cheese of Green County and the adjacent territory in Lafayette, Iowa, and Dane counties is Swiss or Limburger. Dodge County is the center of Brick cheese production. Nearly all the remaining cheese territory is devoted to the production of Cheddar cheese. Wisconsin cheese is shipped directly to every state in the Union.

In conclusion then we may say that there have been a number of conditions and forces in Wisconsin that largely account for our present position in dairying. Nature provided the proper stage,—a land favored in climate, soil

and physical wealth. Foresighted, earnest men, unafraid of work, with courage, enthusiasm and ideals, early saw the opportunity, not only to make two blades of grass grow where one had grown before, but also to make two quarts of milk flow where none had been before. Out of individual efforts have grown mighty institutions, organizations, and enterprises, which somehow have caught the same splendid cooperative spirit of little Denmark and by an incessant series of educational campaigns, these institutions have reached the remotest corners of our Badger State, and have lifted her ever higher in her progress to leadership in one of the world's great industries.

NOTE.—The writer wishes especially to express his appreciation of the helpful spirit and material furnished by the College of Agriculture of the State University, State Dairy and Food Commissioner, J. Q. Emery, Secretary A. J. Glover, and Secretary G. H. Benkendorf.

THE AGRICULTURAL INDUSTRIES OF WISCONSIN

By W. S. Welles, Normal School, River Falls.

GULF of Mexico water is making Wisconsin farmers rich. Why and how?

The most provoking word in a teacher's vocabulary from the student's point of view is "why." It is also the most potent word for its size from the teacher's point of view. If I venture to ask when Wisconsin receives it heaviest rainfall and a student replies "in April, May, and June," I very properly ask him "why." The book says that Wisconsin produces more rye than any other state. The student fixes that fact. He accepts it as truth. But can he make a reasonable attempt at telling the "why"?

I think there are three ends, in the last analysis, that guide man and lead him on in this life: wealth, power or position, and pleasure. Put these in any order or succession to suit the taste, but I am convinced that you will come back to this trinity of ends sought. Man must seek them through his cooperation with the things and forces of the earth about him. Man is successful if he enters into right relations and puts his effort into the scale with nature; he fails if he does otherwise. And here is the common stock from which geography and history grow out as branches. Geography is the consideration of the earth as the scene of man's endeavor to realize the ends of wealth, power, and pleasure, in cooperation with natural things and forces that aid him or thwart him. History is the record of a people's successes and failures in gaining the coveted ends. Let that sink into the mind and then begin going back over the records of nations and see how nicely it checks up. And with the growth of that view the subject of geography steps into place in the front rank of important studies. It is fundamental and illuminating to history. It gives point of origin for mathematics and sciences since it reveals the need of calculation and careful investigation which man had to make in order to ally himself properly with nature in gaining his desired end. Agri-

culture, which is admitted to embody the working parts of nearly all other subjects of study, is dominated by geography. Therefore it seems proper and very fitting to discuss the agricultural industries of Wisconsin from a geographical point of view.

I wish to make good the assertion that Gulf of Mexico water is making Wisconsin farmers rich. They are selling it at the elevator, the starch factory, the warehouse, the cheese factory, the brewery, and the kitchen doors of their dairy customers. They are laying it upon the meat blocks of the country

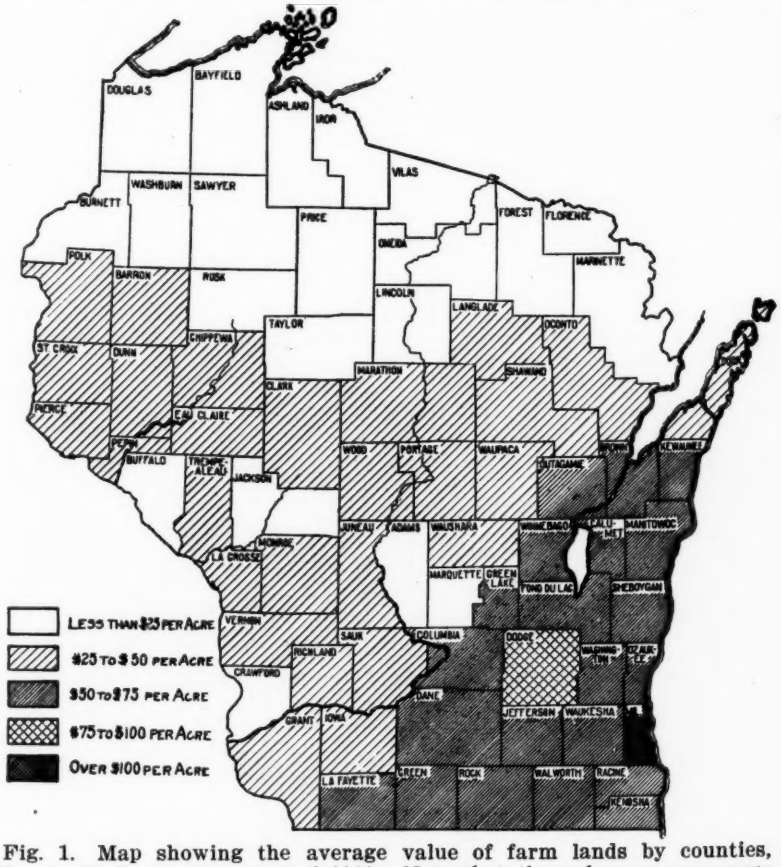


Fig. 1. Map showing the average value of farm lands by counties, according to U. S. census report of 1910. Note that the values are *averages for entire counties.* The best land in any county has, of course, a much higher value than this average.

for a price. They are spreading it upon our bread and sending a golden tide to the tables of the whole land. They are filling our shelves with it in cans marked "peas" and "beans", and it furnished pipe dreams for them and many others. How? Thereby hangs the tale.

Climate with its temperature, pressure and rainfall factors is the great deciding force in agricultural industries and so in the life of any people, and in making Wisconsin farmers rich. As it has worked itself out through glacial

periods and is working still, climate has practically decided which are to be agricultural lands. Through the cyclonic whirls, Gulf of Mexico water is drawn over Wisconsin and descends in showers that turn to gold all they touch. Surface and drainage are in harmony with the preceding and determine soil which, with all the factors named before, marks out the products which influence industries, which call for transportation of finished products to the people who are what they are according as they succeed or fail to realize themselves under their geographical influences.

The above arrangement of related, controlling factors in the lives of Wisconsin people is given entire in order to take notice of the fact that the agricultural industries of the state are not what they are and where they are unless in response to conditions of production on the one hand, and to suitable means of use and transportation on the other.

FIG. 2. STOCK FARM NEAR MINERAL POINT IN SOUTHWESTERN WISCONSIN.

No one should attempt to inform himself generally on the subject of the agricultural industries of Wisconsin without going back to the controlling factors to get the basis for explaining the presence of any product any place in the state and the absence of that product in other parts of the state. It may be a reason of economics, wholly. In that case again, greater returns are realized from one product in competition with others because conditions for its production are better than for the others, considering the opportunities for its use in industries and for its transportation. It is absolutely essential to an understanding of the "whys" and "hows" of the agricultural industries of the state to have a working knowledge of all these factors that make agriculture possible here, and to know enough about the different agricultural products

to be able to say when the conditions present and conditions needed are enough alike to insure production. For example, while one may know the climatic and soil conditions of Dane County he is unable to appreciate the corn producing power of Dane County unless he knows what corn needs in climate and soil. Or, one may know that all conditions are right and suited to oats or hay production in some part of a county remote from transportation facilities and will be unable to appreciate the absence of oats and hay production there until he takes the factor of transportation into account.

So I hope it appears that a knowledge of the agricultural industries of Wisconsin that consists only of a set of statistical tables relating to crops is of very little educational value or satisfaction. But when such information is at one's command and he is able to clear himself reasonably as to "hows" and "whys" at each step, it then becomes a powerful tool in his hands for his or others' benefit through him, and a source of much satisfaction to himself.

The best way to keep this large body of information about Wisconsin, seems to me to be that of putting it in the form of maps of the state. For example, there is a reliable chart of the state that divides it into belts in which the mean annual temperature is 41 degrees or 44 degrees say; there is a chart with lines showing the annual rainfall belts; another shows the belts of soils in the state; another indicates place and amount of corn production, lines of transportation, etc. The value of these and other charts, which one could arrange for himself, is that they condense many facts and figures into a small space and give one a retaining grip on all at once. I would not be without my set of mental maps of Wisconsin by which I can give approximately the climate, surface, soil, productions, industrial and transportation facilities of Wisconsin at a moment's notice for any part of the state. Not only are they valuable with regard to what is true at present but by them one can give reasons why other things are not true, also.

Now let us look at a tabulation of facts about the agricultural industries of the state as a whole in comparison with other states. The source of this information is the 1912 Yearbook of the Department of Agriculture. Dairying which appears in another article in this Journal, is omitted.

Table I. (For 1912)

	Wheat	Corn	Oats	Barley	Rye	Potatoes	Hay	Tobacco
Total Yield							tons	pounds
in thousands of bu.....	3,564	58,262	84,746	24,843	6,240	34,920	3,600,000	54,438,000
Total Yield, rank.....	25th	15th	6th	4th	1st	3rd	7th	7th
Bu. per acre	19	35.7	37.3	29.4	18.3	120	1.6	1290
Yield per acre, rank.....	14th	16th	19th	18th	11th	16th	12th	7th
Av. Yield U. S. 1912.....	15.9	29.2	37.4	29.7	16.8	113.4	1.47	785.5
1870, bu. per A.....	13.1	33.1	34.6	26.3	15.5	86	1.36	946
1870, Yield per A., rank....	15th	11th	3rd	5th	12th	20th	10th	6th
1870, Yield per A., U. S....	12.3	27.1	28.4	22.2	14.1	87.9	1.23	737.8
Farm val. of these crops								
in thousands of dollars....	$2,958	$29,714	$27,119	$13,664	$3,806	$11,873	$43,560	$5,988
Rank in value	8	2	3	4	7	5	1	6

The most valuable product in the state is horses, amounting to $87,115,-

000. This state is 13th among states in the number of horses, 10th in other than dairy cattle, 9th in swine and 21st in sheep.

The first line gives total yields in pounds, tons or bushels. The second line shows Wisconsin's total yield rank among the states; the third gives production per acre; the fourth gives the acre yield rank among the states; the fifth gives the same for the United States that the third line gives for the state and should be compared with it at each item; the sixth, seventh, and eighth lines furnish comparisons with the third, fourth and fifth over a period of forty years. The last lines need no explanation.

Study of the above tables furnishes some very interesting conclusions regarding Wisconsin as a state among states from an agricultural point of view. Many interesting items are of necessity omitted from the list but these are the large ones. However, one is not well informed about this phase of Wisconsin industry unless he knows about the quantity and location in the state of the production of flaxseed, fruit, eggs, cabbage, peas, beans, cranberries, blueberries, and other important items.

In table I, note the following:

1. Hay is the most valuable field crop.
2. Wheat is the least valuable field crop.
3. Wisconsin has more money in horses than in all hay and oats produced annually.
4. Wisconsin ranks first in almost the cheapest product in the list and thirteenth in the dearest product.
5. Wisconsin has eight ranks of ten or less in the list of twelve items.
6. Wisconsin ranks 10th in these twelve items out of forty-two states entered (ascertained by actual count.) This shows Wisconsin is far better than an average which would be 21st place.
7. Wisconsin is ahead of the average acre production for the United States in each of the eight crop items.
8. The acre yield rank is not up to the total yield rank. One asks himself "why?"
9. Wsiconsin's average rank in total yield for 1913 was 8.5. The rank for the same items in 1870 was 14. The state is getting higher rank in some special lines. Rye rank jumped from 12th to 1st place. Wheat went back from 15th to 25th place.
10. In half of the items named Wisconsin has lost state rank in the forty years. She has gained in the other half in which specialization is evident at the present time.

There are many other interesting deductions to be made from the table but space will not permit them here.

Now let us turn away from the situation outside of the state to that within the state. Since the leading items of production constitute such a large part of the wealth of the state, let us see where in the state are the centers of this production.

These centers of production indicate fairly well what part of Wisconsin is suited to the particular item. It does not mean that in these places only can this thing be produced, but it indicates the present location of the center of the producing region of the state in the case of each item. There is usually a good reason for its location.

Again the briefest form is a table. Appreciation of what this table shows will be lacking unless the map of the state is well in mind. The centers are given by counties, and in each case the county named gives the maximum production in the particular item. The Blue Book for 1913 is the source of information. The Wisconsin Geological Survey, Bul. 26, is very valuable, also, in this connection.

Crop	*County Ranking First*
Wheat—Spring	Dodge
Wheat—Winter	Trempealeau
Corn	Dane
Oats	Dodge
Barley	Dodge
Rye	Pierce
Potatoes	Portage
Timothy Hay	Grant
Clover Hay	Fond du Lac
Alfalfa Hay	Green
Wild Hay	Dodge
Buckwheat	Juneau
Poultry	Dane
Sheep	Grant
Swine	Dane
Horses	Dane
Cattle	Dane
No. acres farmed	Dane
Value farm property	Dane

If space permitted, it would be interesting to note what the reasons for these locations are. One or two will be enough to illustrate. Others may be picked out.

1. Dane County has seven first ranks. The soil is good, the climate is favorable, transportation is plentiful and the State University is a stimulating influence all the time in all directions.

2. Dodge County has four firsts. In soil and other factors this county resembles Dane County and is probably a close second in some other items.

3. Other first locations are scattering, showing some special adaptation for production in these particular lines. It may be soil, or climate, or transportation, or any other of the seven limiting factors named early in the article.

These tables furnish small handles for carrying big things and as such are most valuable. But no one should be content with seeing that such and

such things are so. The "why" should be just as apparent as the fact in most instances; if it is not, search.

THE MINERAL INDUSTRIES OF WISCONSIN

By Lilla Braband, Milwaukee.

WISCONSIN does not claim much distinction in the production of minerals, being outranked by twenty-nine states. The total value for 1912 was $14,192,000, which is three-fourths of one per cent of the total mineral production of the United States.

In order of value, the mineral products of Wisconsin were as follows:

	Value, 1912	Per cent of total of U. S.
Zinc	$4,560,900	10.3
Iron ore	2,731,574	1.6
Stone	2,211,847	3.
Clay products	1,044,486	.6
Mineral Waters	869,495	11.3
Lime	825,551	6.
Sand and gravel	664,327	3.
Lead	232,290	.6
Pyrite	70,518	5.5

Wisconsin ranks second among the states in the value of the production of mineral waters; third in lime; third in pyrite; fourth in zinc; fifth in iron; ninth in sand and gravel; tenth in lead; tenth in stone, and twenty-sixth in clay products.

The pig iron made from Wisconsin's ore is valued at nearly $7,000,000 and the pig iron made in the state is valued at about $4,000,000 a year.

Order of rank in production—

Mineral Waters: New York; Wisconsin.

Lime: Pennsylvania; Ohio; Wisconsin.

Pyrite: Virginia; California; Wisconsin.

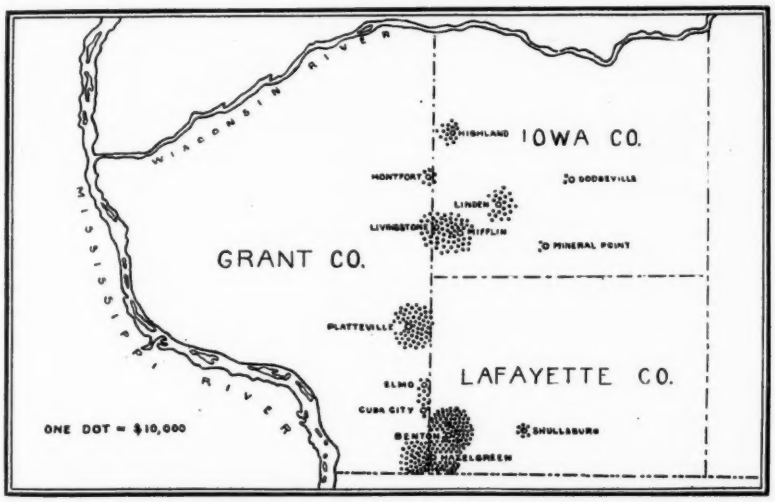
Zinc: Missouri; New Jersey; Colorado; Wisconsin.

Iron ore: Minnesota; Michigan; Alabama; New York; Wisconsin.

Zinc and Lead. These ores are found occurring together in the limestone formations in the southwestern part of the state in Grant, Iowa and Lafayette counties. This district became known as the "Lead Region," because the lead, which usually occurs nearer the surface, was the first to be mined. By 1827 lead mining had become quite general, the maximum production being reached between 1845 and 1847, when lead was the most important metallic product of the state. But since 1860 the production of zinc ore has predominated over that of lead, and during recent years the output has risen so rapidly that now the value of the zinc production is twenty times that of lead. Wisconsin ranks third in the production of primary spelter,

but on account of the high percentage of iron sulphide, falls to fourth place when the zinc content is considered. The principal zinc districts are Platteville, Cuba, Livingston, Shullsburg, Benton, Hazel Green, Linden and Mifflin.

Iron ore. As a producer of iron ore Wisconsin is included in the Lake Superior Region, where the ore is concentrated in certain districts or ranges, two of which, the Penokee-Gogebic and the Menominee, extend into Wisconsin. The Lake Superior iron ores are mined from the ancient rocks (Huronian) and are overlain with glacial drift, the major part of which is clay, sand and gravel. Over certain ranges, as the eastern Menominee and the Gogebic, the drift is relatively thin and the hard rock outcrops are abundant.



Map showing the chief lead and zinc producing districts in 1911. The five dots around Montfort, for example, indicate that about $50,000 worth of lead and zinc was mined in that district in 1911, while near Platteville 60 dots indicate over $600,000 worth mined in that district.

Three-fourths of the iron mined in the United States comes from the Lake Superior Region, but only about two per cent of this is credited to Wisconsin. Iron ores are also mined in small quantities from the ancient rock of the Baraboo Ridge in Sauk County; and from the younger rocks (Silurian limestone) of Iron Ridge in Dodge County. The iron mines which produce more than 50,000 tons are the Montreal and Cary in Iron County, the Mayville in Dodge County, and the Florence in Florence County. On account of the lack of coal, Wisconsin is at a disadvantage in the smelting of iron ore, contributing but one per cent, about $3,800,000, of the total value of the pig iron produced in the United States. The largest smelters are at Milwaukee and Ashland.

Stone. Third in importance among the State's mineral products is that of the quarries, the principal stones produced being granite, limestone, and sandstone.

Granite, which is an igneous rock, is quarried chiefly in the central part of the state in Green Lake, Marquette, Waushara, Waupaca, Marathon, Oconto, and Marinette counties. The granite is often fine grained, takes a high polish and is beautifully colored, varying from dark red to gray or white. Much of the granite quarried is used in connection with monumental work; but the principal use is in the manufacture of paving blocks. Small quantities are used for building purposes, and as crushed stone for road building and concrete.

Limestone, which is a sedimentary rock, occurs principally in the eastern, southern and western parts of the state. It is quarried in thirty-one counties. Over two-thirds of the limestone produced is crushed for use in road making, as a flux in the iron furnaces, as railroad ballast, and for concrete. In many of the eastern counties the limestone is manufactured into lime, of which Wisconsin is one of the leading producers.

Quartzite is quarried in Sauk County, being mainly used in the manufacture of fire brick.

Sandstone of a light color abounds in the central and western parts of the state, south of the granite area; while an older, red colored sandstone, or brownstone as it is commonly called, is found in the northern part along the shore of Lake Superior. The light sandstone which is suitable for building purposes belongs to the Potsdam formation. It is quarried at only a few places. The brownstone industry on the shore of Lake Superior is now nearly extinct.

Clay products. Although Wisconsin ranks only twenty-sixth among the state in clay products, the total value of the clay products exceeds one million dollars. The chief product is common brick which represents 80 per cent of the total output. The leading clay working county is Milwaukee which manufactures a special kind of brick, known as cream brick.

Mineral waters. Wisconsin leads all other states except New York in the production of mineral waters, their value, however, being only one-fifth that of the value of the zinc produced. The sales for 1912 amounted to 6,045,719 gallons, at an average price of fourteen cents a gallon. Many afford water of medicinal value, as the mineral springs of Waukesha (twelve in all) which have a wide reputation. Other springs are located at Sheboygan, Madison, Sparta, Ashland, Wauwautosa, Palmyra, Green Bay, Chippewa Falls, and Prairie du Chien.

Sand and gravel. Sands are classified according to their use, as building, paving and moulding sands. As compared with the other mineral products of the state, the value contributed by this item is relatively small.

Pyrite. Wisconsin ranks fourth in the production of pyrite, which is used in the manufacture of sulphuric acid, but its comparative value, like the sand and gravel, is not large.

THE MANUFACTURING INDUSTRIES OF WISCONSIN*

By R. H. Whitbeck, University of Wisconsin.

RECOGNIZING the importance of wise and efficient direction on man's part, we shall discover that the manufacturing industries of Wisconsin, are to a large degree an outgrowth of certain natural or geographical conditions which prevail in the state.

The earlier the stage of development in which a state or a region is, the more fully its industries are shaped by natural conditions. Compared with New England or New Jersey, Wisconsin is a young state and its manufacturing is still largely shaped by its natural products.

Factors Which Influence the Location of Manufacturing Industries

Transportation. Manufacturing involves the bringing together of raw materials and the distribution of finished products, and means of transportation are an all-important factor. Water transportation is cheaper than rail, and cities which can offer both rail and water transportation have an advantage. The long line of cities on the shore of Lake Michigan exemplifies this principle. These cities do not make use of water transportation so much as they do of rail transportation; but the fact that if railroad rates are not reasonable shippers can use the lakes, tends to keep railroad rates lower.

Fuel and Power. Another factor of primary importance is the cost of power for running machinery. To a large extent this depends upon the cost of coal, delivered at the factory. Other kinds of power, as electric power and water power, are used, and the latter is growing in importance in Wisconsin. In fact, the state is among the foremost in available water powers. Steam power now constitutes three-fourths of all the power used in the mills of the state.

Northerly Situation. The center of population and manufacturing in the United States has moved westward along the 39th parallel of latitude, while middle Wisconsin is 300 miles north of this.

The larger part of Wisconsin was densely wooded. On the northern pine-lands it costs a settler more in labor or money to clear the cut-over lands of brush and stumps than the original price of the land. This is one of the reasons why northern Wisconsin has developed slowly.

The Value of Situation on One of the Great Lakes. That Wisconsin's situation on Lake Michigan has been a very great advantage in the development of the eastern part of the state may be seen from these facts:

1. Both the largest manufacturing city of the state and the next largest are on this lake, and one of these cities manufactures goods whose value is nearly ten times that of the manufactures of any other city in the state.

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*Abridged from the writer's treatment of the subject in Bulletin XXVI, Wis. Geol. and Nat. Hist. Survey, 1913, Geography and Industries of Wisconsin.

2. There are eleven manufacturing cities on the shore of Lake Michigan and Green Bay, as against two on the Mississippi River.

3. The population of the eleven counties touching Lake Michigan is greater than that of any thirty other counties in the state.

The Lack of Coal Mines. Wisconsin produces no coal, a fact which might be expected to operate unfavorably upon manufacturing. Possibly it does, though only to a limited extent. Indiana, for example, lies directly in

Fig. 1. Map showing the distribution of villages and cities in which an average of 500 or more employes are engaged in manufacturing establishments. The smallest dots represent places having an average of 500 to 1,000 such employees. The size of the dot indicates the importance of the place as a manufacturing center. Based upon reports of the State Factory Inspector and of the U. S. census of 1910.

the trunk line territory. It is crossed by the 39th and 40th parallels, along which the centers of population and of manufacturing have moved. It has a milder winter climate, was more readily cleared of forests, was settled earlier, and has an abundance of coal. Yet the value of manufacturing per capita in Indiana in 1910 was $215 as against $254 in Wisconsin. Missouri has coal, lies directly in important trunk line territory, and has a mild climate, yet the

per capita value of manufactures in 1910 was only $177. The per capita value in Michigan the same year was $245, and in Illinois $206.

Conditions Which Make For Diffusion or for Concentration of Manufacturing

Of nine important branches of manufacturing in Wisconsin, six are somewhat widely distributed over the state, and three are concentrated in a few places. There are, of course, varying degrees of diffusion or concentration shown by the different branches. The lines of manufacturing which are widely or considerably diffused are:

1. Butter and cheese, about 3,000 factories.
2. Lumber and timber products, about 1000 mills.
3. Flour and grist mills, over 300.
4. Malt liquors, about 140 breweries.
5. Furniture, about 100 factories.
6. Metal working, chiefly iron and steel products, about 300 plants, not counting railroad round-houses or places which regularly employ less than ten men.

Nearly one-half of the metal working plants are in Milwaukee and approximately 80 per cent are in the southeastern quarter of the state.

Of 57 paper and pulp mills, more than thirty are along the lower Fox River between Lake Winnebago and Green Bay.

Of 32 tanneries, 12 are in Milwaukee.

Causes of the Diffusion of Certain Manufactures. The three thousand BUTTER AND CHEESE FACTORIES are widely scattered over the state, but they are by no means uniformly distributed. Since their raw material is milk or cream, which is produced on the farms and which must be made into butter or cheese without delay, the factories are scattered among the dairy farms at frequent intervals.

The forests yield the raw material for the lumber mills and other wood-using establishments. The timber is scattered over the entire northern half of the state and this has naturally led to a wide distribution of SAW MILLS, PLANING MILLS, and other wood working establishments.

In addition to the factories and mills which use raw products produced in the state, plants of large capacity making textiles, knit goods, boots and shoes, and automobiles are being established, mostly in the southeastern part of the state.

Water Power and Its Relation to Manufacturing

In a state that has no coal, waterpower is important. Only three states in the Union have developed more waterpower than Wisconsin: they are New York, Maine, and Massachusetts, all of them long-settled states. The total waterpower in use in the state in 1911 was about 180,000 horse-power. Only one important river, the Fox, has anything approaching its total available power developed. At nearly a score of points along the upper half

of the Wisconsin River, valuable waterpowers have been developd. A still greater number of undeveloped powers exists.

Manufacturing Cities

As a rule, manufacturing on a large scale is most advantageously carried on in cities. The Mississippi River, strangely enough, has called forth only one city of over 10,000 population, La Crosse. The Chippewa Valley has given us one, Eau Claire. Lake Superior has two, Superior and Ashland; both of them owe their location to excellent harbors and both of them are

Fig. 2. Map showing the distribution of wood working mills. Based upon the Annual Report of the State Factory Inspector 1910. Mills which employ less than 20 men not considered.

outlets of iron mining regions. The Rock River basin has developed three good sized cities, Madison, Janesville, and Beloit.

The most notable concentration of manufacturing cities and towns on any river of Wisconsin is in the Fox River Valley, including the shore of Lake Winnebago.

By far the most effective geographic influence in promoting the growth and fixing the location of cities in Wisconsin has been Lake Michigan, including Green Bay. The number of cities which are located here shows how

effective deep-water transportation is in encouraging the growth of commercial and industrial centers.

Figure 1 shows the distribution and relative importance of the chief manufacturing cities. A line drawn across the state from the northeast to the southwest corner so divides the state that about one-fourth of the total area is southeast of this line and three-fourths is northwest. In the one-fourth there are 46 places having 2,500 or more people, while in the remaining three-fourths are 27 such places (1910).

SUMMARY OF FACTS PERTAINING TO MANUFACTURING

1. By far the most important branch of manufacturing in the state has ever been the wood-working industry. The gold of California is a minor item when compared with Wisconsin's lumber. The total value of the wood products exceeds $100,000,000 a year.

2. In point of value to the state, the manufacture of butter and cheese is second to the wood-working industry. Three thousand factories and creameries are producing over $60,000,000 worth of butter, cheese, and condensed milk annually.

3. There has been a remarkable growth in the manufacture of iron and steel products in the state in recent years. The total value exceeded $54,000,000 in 1909.

4. The tanning of leather is the fourth most valuable branch of manufacturing. Milwaukee leads all of the cities of the Union in this industry. The total output reaches $45,000,000 a year.

5. The brewing of malt liquors is prominent in Milwaukee, and gives the city third rank in the United States as a brewing center.

6. Slaughtering and meat packing has grown very rapidly in recent years; the major part of it is carried on in Milwaukee and nearby cities.

7. The four regions of Wisconsin where manufacturing cities have become most numerous are (1) along the shore of Lake Michigan, (2) in the Fox River Valley, (3) in the Rock River Valley including Madison, (4) in the valley of the upper Wisconsin River.

8. Over one-third (in value) of the manufactured products of the state are made in Milwaukee and fully 80 per cent are made in the southeastern quarter of the state.

9. The southwestern quarter is almost wholly agricultural, La Crosse being the only city with large manufacturing interests.

10. In 1849 Wisconsin ranked 19th among the states in manufacturing and in 1909 it ranked eighth, but in proportion to population it leads all of the states west of Ohio.

11. Down to recent years, the manufacturing industries have been closely related to the natural resources of the state, deriving the larger part of the raw materials from the state.

12. Aside from the natural resources, the Lake Michigan water-front seems to be the state's greatest geographical asset, as is evidenced by the num-

ber of manufacturing cities on the shore of the lake.

13. There were nearly 10,000 manufacturing establishments in Wisconsin when the U. S. Census of 1910 was taken, but 9,000 of these were relatively small. Three-fourths of the manufactured goods were produced in less than 1,000 mills, and 86 of the largest establishments turned out over one-third (in value) of all the goods manufactured.

GEOGRAPHY OF THE WINNEBAGO AND LOWER FOX RIVER VALLEY

By W. R. McConnell, Oshkosh Normal School.

THIS article attempts a brief explanation of the principal geographic features of Lake Winnebago and the lower Fox River Valley, and discusses the influence of these geographic conditions on the settlement and industrial development of the region. The greater part of the discussion is concerned with the vicinity between Lake Winnebago and Green Bay. The accompanying map (Fig. 1) shows the location of the principal places referred to in the report.

The Fox River drains an area of 8078 square miles. The principal tributary is the Wolf River which rises in the northeastern part of the state and joins the upper Fox about ten miles above Lake Winnebago. The Wolf River and the upper Fox drain an area of 6978 square miles. Lake Winnebago is a prominent feature of the river and divides it naturally into two sections, the upper and lower Fox. The upper Fox flows through glacial drift and has a fall of only 40 feet in a little more than one hundred miles along its meanderings.

The lower Fox drains an area of 1100 square miles. The river flows northeastward through a valley which is abruptly limited on the east by a precipitous rock wall rising from 100 to 200 feet above the lower portions of the valley. On the west, the surface slopes upward very gradually for fifteen to twenty miles. From Lake Winnebago to Green Bay the river flows over a bed of limestone. In this distance, which is approximately 35 miles, the river has a fall of 170 feet. A series of falls so distributed as to be completely and economically used are formed over the heavier and more resisting ledges of the limestone bed. Locks along the river make it possible for steamboats to ply between Green Bay and Oshkosh and the floor of the valley has been utilized by rail road and electric car lines. Lake Winnebago is a natural reservoir with an area of 350 square miles, and provides in time of either flood or drought a steady, reliable flow. The aggregate power of the falls is estimated at 47,000 horse power. Important manufacturing centers have grown up at the water power sites along the river. Fig. 2 shows the horse power developed at the various points.

Lake Winnebago and the lower Fox River Valley is one of the most conspicuous topographic features of the state, and river and valley have in-

fluenced the historical development and the industrial life of Wisconsin in important ways.

Settlement and Development

It is impossible to confine a discussion of the influence of the geographic features on the development of any particular region to the region itself. The development of the Fox River Valley is vitally connected with outside areas and conditions such as the lumber industry of the entire state, as well as other sections of United States and Canada. Traffic on the Great Lakes and the development of the Mississippi Valley are other factors which greatly influenced the settlement and industrial life of the area under discussion.

FIG. 1. MAP OF LAKE WINNEBAGO AND THE LOWER FOX RIVER VALLEY.
(Map by courtesy of the Macmillan Co.)

The location of Wisconsin between the Great Lakes and the Mississippi River is one of the most important geographic factors in the history of the state. The Fox-Wisconsin River valleys have formed the great natural highway between the two. Over this natural route passed the first white men who crossed the state, the early French missionary and the fur trader. Later it guided the great stream of immigration which poured into the Mississippi Valley from the east.

In 1840 the five counties comprised in the area with which this paper deals—Fond du Lac, Winnebago, Calumet, Outagamie and Brown—had a

combined population of 2,656.* Geographic conditions determined the occupations and mode of life of the early pioneers. Their isolation subjected them to many hardships. Their personal possessions were confined to the absolute necessities of life. Their homes were constructed of logs and the household furniture was manufactured from such materials as could be obtained from the woods. Flour was often made by grinding wheat in coffee mills. The distance of the region from large markets, and the prevailing high cost of transportation meant low prices for the surplus produce of the pioneer and high prices for merchandise. In 1837 a barrel of pork sold in Green Bay for $40.00 in cash, and at the same time flour shipped from Buffalo sold for $20.00 per barrel.**

It was these early pioneers who began the subjugation of forest and field, the establishment of commerce and the building up of the industrial life of the valley through the utilization of its natural resources. Their work has gone on unceasingly up to the present time.

Up to about 1840 the chief business in the Fox River Valley was the fur trade, first by the French Companies, then English and lastly by the American Fur Company established by John Jacob Astor and having its headquarters at Green Bay. After that date agriculture and manufacturing supplanted the fur trading industry.

When Wisconsin became a state in 1848 a stream of immigrants both from foreign countries and from the eastern United States poured into the valley. The communal life of trading days disappeared and a diversity of employment was introduced. In 1850 the population of the counties concerned in this paper was 32,635. Between 1850 and 1874 the valley cities—Oshkosh, Green Bay, Appleton, Neenah and Menasha were incorporated.***

Industries

Agriculture. To the early settlers the region seemed best suited to the raising of wheat. The favorableness of the soil, the cheapness of fertile land, the scarcity of labor and capital and the fact that wheat has always been a great cash crop are some of the reasons given for the "persistent tendency to grow wheat exclusively."‡ The farmer raised wheat year after year because it paid him to do so. The reasons assigned for the decline of wheat growing are declining profits and competition arising from diversified farming. Dairying gradually developed into the characteristic farm industry. The region is especially adapted to it, because of soil, climatic conditions, and nearness to large markets. It benefitted the soil and proved more profitable. Thus wheat growing was forced out upon the less expensive western lands.

Dairying is at present the dominant farm industry in the valley, but

*Wis. Blue Book, 1911, tables pp. 49-50.
**Lawson, *History of Winnebago County*, pp. 205-207.
***McLenegan: *Wisconsin Historical Society Proceedings*, 1909 pp. 284-285.
‡Thompson: *Rise and Decline of the Wheat-growing Industry in Wisconsin*, p. 23.

some wheat is still raised, much hay is produced, and the farmers are devoting considerable areas to the cultivation of sugar beets. Market gardening is carried on to some extent.

Manufacturing Industries. One of the most important of the early industries in the Fox River Valley was the manufacture of lumber. The vicinity was originally covered with a forest of oak, maple, birch and evergreen trees. The first saw mill was erected in Oshkosh in 1846. The logs for the mill were floated down the Wolf and the upper Fox rivers. Beyond Oshkosh the logs could not be readily floated and the advantages of the city as a saw mill center were thus readily recognized. Between 1849 and 1856 the lumber industry in the valley was rapidly developed by men coming to Oshkosh from the East. Such noted valley pioneers as Philetus Sawyer, Carleton Foster, James Jones, Richard T. Morgan and S. B. Paige came between the above mentioned dates.‡

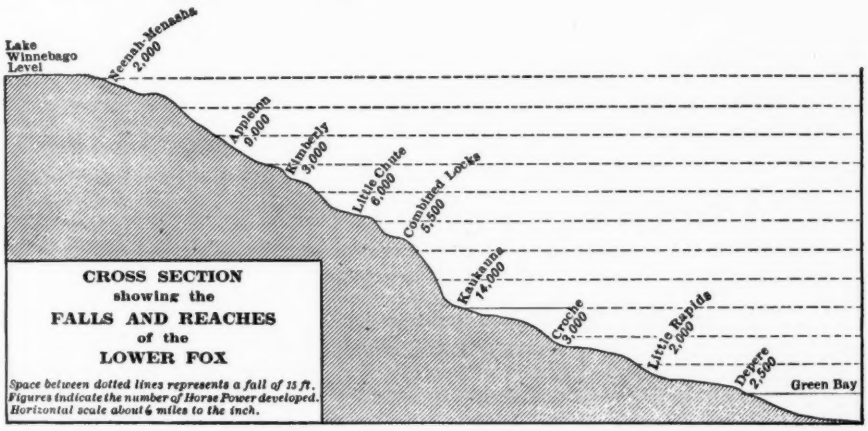

FIG. 2. After Mitchell, Courtesy of the MacMillan Co.

Between 1870-1880 the upper Wolf River was improved by means of dams so that logs could be floated from the far north. In 1879 the amount of logs rafted to Oshkosh was 120,646,000 feet.* Saw mills were also operating at this time on a smaller scale in other valley towns—Neenah, Menasha, Appleton, and Green Bay.

The lumber industry declined with the exhaustion of the local forests, but in Oshkosh it is still a prominent feature of the commercial life. The Paine saw mill located here still operates on a large scale and the Paine sash and door factory is said to be the largest of its kind in existence. In addition to the Paine factory, there are several other concerns manufacturing sash and doors and other lumber products. Menasha has the largest wooden ware factory in the world. It consumes 30,000,000 feet of timber annually and ships 2000 carloads of ware. The timber most used is pine and bass-

*Harney: *History of Winnebago Co.*, p. 296.
‡McLenegan: *Wisconsin Historical Society Proceedings*, 1905, p. 285.

wood. The timber is brought from the northern part of the state, from Canada and from the far West. Transportation facilities in the valley have made it possible to transport raw materials in the way of lumber from remote distances and use the water power for the manufacture of finished products. Neenah has a hardwood-products factory which makes a specialty of veneered doors.

Flour. The manufacture of flour was another important early industry. The water power developed by the river was utilized for operating the mills. The manufacture of flour beyond that needed for local consumption came about because the surplus wheat of the community, when made into flour, could be more profitably transported to distant markets. In 1880 there were seven flour mills in operation in Neenah, manufacturing on an average an aggregate of 1,425 barrels of flour per day, which sold at an average price of six dollars per barrel.** Menasha had five mills in operation at the same date. Other flour mills were located at De Pere and Little Chute. The flour mills declined with the wheat industry of the state. Practically all of the mills have been dismantled. One still operates at Neenah.

It is of interest to note that the cities of the Fox River Valley have made quick adjustment to the changing conditions, brought about by the thinning of the forest, the decline of the wheat growing industry and the changed conditions of transportation. They have adapted their resources to meet the needs of the hour, and have maintained a steady growth through the rise of new industries on the ruins of the old.

Paper. The chief industry to supplant the manufacture of lumber and flour was that of paper making. The enterprise had its beginning in an early day. In 1855 a paper mill was erected at Appleton. It was at Neenah, however, that the industry first became largely profitable and attracted attention to the possibilities of the enterprise in the state. The first paper mill was built here in 1865-66. In 1872 the Kimberly-Clark Paper Company organized at Neenah and has since become the largest concern for that industry in the world. This concern at present has mills in operation at Neenah, Appleton, and Kimberly. The other water power sites on the lower Fox—Menasha, Kaukauna, De Pere, and Little Chute—all have paper mills in operation. The John Strange Paper Company at Menasha changed in 1887 from a pail factory to a paper mill.***

Before 1871 all Wisconsin paper was made of cotton rags, white paper waste, or straw. This same year a mill at Appleton began to make pulp from poplar; later, spruce and basswood were used. By 1890 the wood pulp process had enormously developed and with the invention of the stereotype cylinder making it possible to use dry paper for printing, wood pulp paper was made available and the price of print fell from $11.00 to $1.20 per

**Harney: *History of Winnebago County*, p. 211.
***Lawson: *Paper making in Wisconsin; State Historical Proceedings*, 1909, pp. 276-278.

cwt. The Fox River mills have since been taxed to their limit to supply the demand. Paper is now made chiefly from hemlock from the state and spruce from Minnesota and Canada. The supply of this material is limited and unless the pulp of other trees can be substituted the Fox River Valley towns may, in the not distant future be forced to adjust themselves to another industry.

Other Industries. It is impossible to interpret here all the remaining industries of the valley. Bricks are manufactured from the lacustrine clay deposits at Kaukauna, Appleton, De Pere, and Green Bay. Shoes and stoves are made at Neenah. Knit goods are made at Appleton and Menasha. The chief cities of the region—Oshkosh, Appleton and Green Bay—had in 1905, 346 manufacturing plants in operation, and manufactured products valued at over $20,000,000. The Fox River towns are commercial as well as manufacturing centers; they are all easy shipping points.

In addition to operating factories, the water power is utilized for generating electricity which is used for lighting purposes and for operating electric cars running between Neenah and Green Bay.

Scenery. The beautiful natural scenery of the region is not an unimportant economic item. The charm and beauty of Lake Winnebago and vicinity has materially increased the wealth of the region. The delightful climate combined with the scenery has led to the erection of many summer homes. The lake invites healthful recreation and has varied attractions. Fish are obtained from its waters and it is a resort for large numbers of water fowls.

The possibilities of the lower Fox River Valley are by no means fully developed. Federal aid has been asked for. The writer is unable to say just how much of a concerted movement has been made in this direction, but thus far the effort to secure such federal aid has been ineffectual.

THE DRIFTLESS AREA OF WISCONSIN

By Supt. C. E. Slothower, Platteville, Wis.

THE driftless area lies principally in southwestern and western Wisconsin. It also includes parts of the adjacent states, Illinois, Iowa, and Minnesota. The boundary is approximately as follows: starting from the Mississippi River near the mouth of the Chippewa River it extends northward to a point about twenty-five miles north of Menomonie where it turns sharply towards the south-east passing near Eau Claire, Augusta, and Neilsville; here it turns northeastward reaching its most northern limit north of Wausau. From this place it turns sharply southward, passing near Kilbourn, Baraboo, Madison, and Monroe into Illinois. In Illinois it runs nearly parallel to the Illinois-Wisconsin boundary and about twenty miles from it. The western boundary is not far west of the Mississippi River and approximately parallel to it.

Into this region, embracing nearly one fifth of the state, the glaciers that once covered the rest of the United States north of the Ohio and Missouri rivers never came. Here, the work of degradation has continued practically without interruption. Here, side by side, are regions physiographically old and physiographically young. Such conditions afford a rare opportunity for the study of the results of glaciation upon economic conditions.

Anyone familiar with the characteristics of a glaciated region, readily perceives a marked change in surface conditions soon after he enters this area. Here the rounded and oval topped hills of the drift disappear and

Fig. 1. Generalized map showing the bed rocks which predominate in various parts of the state and the boundary of the Driftless Area.

in their places are sharp angled ridges separating deeply cut systems of valleys all symmetrically arranged and perfectly adjusted to each other. The sluggish streams, swamps, and lakes of the drift area are here replaced by rapid rivers which, beginning as small rivulets on the highest slopes, increase in size by reason of numerous confluent branches as they pass downward to join larger trunk streams which in turn wind away through the land to lower levels.

The steep slopes facilitate the rapid running off of the surface waters thus increasing their erosive action both on account of the increase in volume and also the increase in velocity. Farming, under such conditions, is more difficult than in a more level country because the richest soils are rapidly carried away leaving the surface cut by many ditches and with the unproductive subsoil exposed.

Almost everywhere in the glaciated area, the surface of the land is strewn with rounded boulders and pebbles, and the soil is composed of rounded stones mixed with sand and clay derived from the destruction of local rocks, or, of bed rock found hundreds of miles northward. In the driftless area, there are no rounded granitic boulders. If loose stones appear upon the surface, they are flat and more or less angular, and they are like the bed rock of the locality. Whenever there are outcroppings of the bed rock they are found to be arranged in strata. The soils are here derived from the decay of the bed rocks, and they too are usually roughly stratified.

Where the soils have been derived from the decay of limestone, they are rich. For this reason, the soil of the southwestern counties is very productive. Where the soils have been formed from the disintegration of sandstone, they are unfertile and of small productive value. More than half of the driftless area, especially the northeastern portion, is derived from the Potsdam sandstone, and hence is very sandy.

The driftless area not only affords a greater variety of scenery than the glaciated area, but it also has, in many places, features of surpassing beauty. Such are the Mounds at Blue Mounds and near Platteville, the Dalles of the Wisconsin, the Devil's Lake region, the castle-like monadnocks near Camp Douglas and the Bluffs of the Mississippi.

A very good general idea of the Driftless Area may be obtained from the various railroad lines which cross it. The Chicago and Northwestern Railroad has a line which runs from Madison westward to Montfort, where one branch extends southward through Platteville and Cuba City to Galena, Illinois, and another branch extends westward to Fennimore and Lancaster. Usually in a hilly country railroads follow the streams because the level flood plains there present the fewest difficulties to road building. The Northwestern line from Madison to Lancaster, however, follows the highest land, thus giving the traveler a splendid view of the country. The railroad follows the elevation known historically as The Military Ridge. This extends in winding curves from Madison westward to Blue Mounds; here it turns southwestward passing near Dodgeville to Fennimore from which place it continues westward to the Mississippi. This remarkable elevation forms the dividing line between the Wisconsin River to the north and the Pecatonica and Sugar rivers to the south. The northern slope of the divide is steeper than the southern. The streams here are swift and flow through deeply cut valleys. The streams which flow southward are less rapid especially in their lower courses and in consequence of this they have, in

some cases, built up wide flood plains through which they flow in beautiful ox-bow curves. A good example of such a condition is found along the course of the Pecatonica between Mineral Point and Calamine. Formerly the hills were covered with timber which checked rapid erosion; in recent years the timber has been cut and the hills are cultivated. Careless tillage has resulted in largely increased cutting away of the soil. As a result of this the smaller streams have carried down their slopes more material than the larger trunk streams have been able to transport. In this way out of the excess of material a broad flood plain has been built up through which the river winds in splendid curves. Another illustration is afforded by the Fever River. In early days steamboats easily passed up the stream to Galena, Illinois, which was then the chief point of entry into the southwestern region.

FIG. 2. TYPE OF FARM LANDS IN THE HILLY PART OF THE DRIFTLESS AREA OF WISCONSIN.
Scene near Black Earth, Dane County.

Now the river has received more sediment than it has been able to transport to the Mississippi, consequently it has become so choked with mud that steamboats can no longer pass through it.

The most conspicuous and also most interesting surface features in the driftless area are the mounds. Blue Mounds, standing near the line between Iowa and Dane counties, are the largest. Platte Mounds near Platteville are three in number. Sinsinawa Mound is near Dubuque.

These elevations are similiar in structure and owe their origin to similiar conditions. They rise from the Trenton and Galena limestone of the

region. In their sloping sides are found Maquoketa shale and the top layers are of Niagara limestone which in these places is of more than usual hardness. There was a time when the land all stood at a higher level. The mounds are a remnant of this former elevation, the locally hard silicious Niagara limestone having here delayed the process of erosion.

The Chicago and Northwestern Railroad between Madison and Baraboo follows quite closely the border line between the drift area and the driftless area. The main line of the Chicago, Milwaukee and Saint Paul Railroad, between Portage and Saint Paul, enters the driftless area near Kilbourn. Here on the old battle line between glaciers and the land they never conquered one has an unparalleled opportunity to make a comparative study of the effects of glaciation.

Devil's Lake, near Baraboo, occupies a comparatively small but deep basin surrounded by bluffs of quartzite which in glacial times were partly overridden and modified by the advancing ice. A river, similar to the Wisconsin, formerly occupied this basin. In many places, the observer may easily trace its old bed with the attendant bluffs. The moraine formed by the glacier twice crosses the course of this preglacial stream, thus cutting off that part of the channel now occupied by the lake. Formerly, when the waters from the melting glaciers were abundant, the level of the lake was much higher than at present.

Only a few miles from Devil's Lake at Kilbourn, are the Dalles of the Wisconsin. Here the Wisconsin River flows through a deep gorge of great beauty, carved out of the sandstone bed through which it flows. In preglacial times, the river followed a different channel. As a result of the steepness of the slope and the large volume of water from the melting ice, the stream was soon able to deeply imbed itself in the soft sandstone. The process of cutting was facilitated by the peculiar system of jointing of the rocks which has directed the process of erosion. On either side of the main stream, the branch streams have also imbedded themselves in deep gulches with precipitous sides.

Northwestward, beyond Baraboo, there is a level sandy plain which extends away to the northward covering the larger portions of Adams, Juneau, and Monroe counties. Near Camp Douglas there are masses of rock which suggest in some places old castles or, in others, the standing chimneys of burned structures. These are remnants of an earlier stage of degradation. Like monuments, they remain to tell the history of past geological ages.

At Tunnel City, the Saint Paul line enters the La Crosse River valley. La Crosse County is similar in structure to the southwestern section of the state. Here the streams have deeply imbedded themselves between sharply formed dividing ridges such as are found near West Salem. Many of the roads of the county are built along these deeply-cut valleys, locally known as

coulees. At the upper extremity of a valley, a divide between one coulee and the adjacent one may be so steep that progress is very difficult.

The bluffs along the upper Mississippi resemble in structure the mounds of the southwestern part of the state. A typical example is found near Trempealeau, where they form a high, elongated ridge capped with layers of Niagara limestone. Back of this range of bluffs is a level plain which extends northward to Galesville, and from the Trempealeau River to Black River. Through this plain these rivers wind entering the Mississippi through gaps in the bluffs.

Three of the main rivers of Wisconsin flow from the drift-covered area across the driftless area and enter the Mississippi. These are the Wisconsin, the Black, and the Chippewa. During the time when the glaciers were disappearing, these streams received more sediment than they could transport. In consequence of this their beds were built up out of valley drift which in some cases was carried outward to the Mississippi. The Chippewa carried forward so much material that the Mississippi was obstructed and formed the expanse known as Lake Pepin. In later times, the streams have been able to lower their beds into these older deposits. In doing this, terraces have been formed, made up principally of drift material.

It is interesting to consider what effects glaciation would have produced in the driftless area. Where the glaciers passed, they lowered the hills, filled former drainage lines or obstructed them with deposits of drift and covered the surface with an unevenly distributed layer of soil composed of sand, clay, pebbles, and rounded boulders. In the lower places of the drift there are many swamps and lakes. With the exception of the swamp and lake area, the drift soils are usually productive. The lowering of the hills makes road building less difficult.

If the glaciers had continued in their courses over the driftless area, it is probable that the surface elevations would here as elsewhere, have been consideraby reduced; valleys would have been filled; and an imperfect drainage system would have been established. The great sandy areas in the northeastern part of the driftless area would have been covered with a richer soil left by the glaciers. Had the glaciers covered the driftless area, the scenery would have been less diversified, but the productive value of the land would have been greater. Road building, which now is often a perplexing problem in the driftless area, would be less difficult, and furthermore, farmers would not constantly need to be devising ways and means to prevent the richest soils of their fields from washing away.

Prof. R. H. Whitbeck, in a paper entitled, "Economic Aspects of Glaciation in Wisconsin," shows conclusively that the driftless area would probably have been made more productive by glaciation. A brief summary of some of the comparisons made in that paper is given below:*

***Editor's note.** **Credit for a considerable part of the work involved in these comparisons is due Miss Mildred Aldrich, who treated this subject in a graduating thesis at the University of Wisconsin.**

Comparison of Percent of Improved Land in 12 typical counties, 6 in the sandstone and 6 in the limestone belt: Excess in favor of drift covered counties, 10½ per cent.

Comparison of Crop-values Per Square Mile of Total Area: Excess in favor of drift, in sandstone belt, 10 per cent; in limestone belt, 31 per cent.

Comparison of Percent of Uncleared Land (southern half of state) in driftless area, 27 per cent uncleared; in drift area, 11 per cent uncleared.

Comparison of Crop-values Per Square Mile in 4 Counties Crossed by the Terminal Moraine: Sandstone, average value of all crops per square mile, drift, $2776; driftless, $1968. Limestone, average value of all crops per square mile, drift, $3828; driftless, $2690. Excess in favor of drift of 40 per cent.

Comparison of Crop-values in Two Chains of Townships, one on each side of the terminal moraine: Excess in favor of drift—in sandstone belt, 11 per cent; in limestone belt, 36 per cent.

Comparison of Crop-values per Square Mile in 20 Townships Chosen at Random: Excess in favor of drift, in sandstone belt, 23 per cent; in limestone belt, 38 per cent.

The foregoing crop-value comparisons involve 200 townships scattered through 40 counties.

Comparisons in Dairying and Stock Raising: Of the leading 10 counties in the production of cheese, Nos. 1, 2, 4, 7, 9, 10 in rank are drift-covered; Nos. 5, 6, 8 are driftless; No. 3 is half drift-covered. Average production of cheese, per county, in drift-covered counties, 10,000,000 lbs. Average production of cheese per county, in driftless counties, 7,000,000 lbs.

Of the leading 10 counties in the production of butter, Nos. 1, 2, 3, 4, 5, 9 in rank are drift-covered; Nos. 6, 7, 8, 10 are driftless. Average production of butter per county, drift, 4 1-3 million lbs. Average production of butter per county, driftless, 3½ million lbs.

Excess in favor of drift, cheese, 40 per cent; butter, 25 per cent.

In the number of all farm animals, excess in favor of drift counties, 14 per cent.

Comparison of the Productivity of the Soil: Average of four principal crops, corn, oats, barley, potatoes:

	Bushels per acre	
	Sandstone	Limestone
Drift	47.8 bu.	52.0 bu.
Driftless	35.5 bu.	51.1 bu.
	12.3 bu.	.9 bu.
Excess	33 per cent	2— per cent

Conclusion: Glaciation benefitted agriculture in the limestone belt primarily by smoothing the topography and thus rendering a larger proportion of the land tillable; not so much by improving the quality of the soil. In the

sandstone belt, the drift brought in by the glaciers considerably improved the quality of the soil. Considering the 10,000,000 acres of drift covered land in the southern half of the state, the benefit arising from glaciation is not less than $2 per acre a year, or $20,000,000.

THE INFLUENCE OF THE MISSISSIPPI RIVER IN THE DEVELOPMENT OF WISCONSIN

By B. A. Stickle, Normal School, La Crosse.

FROM the mouth of the St. Croix River to the Illinois-Wisconsin line, the Mississippi is the western boundary of the state of Wisconsin. Throughout this distance of approximately 250 miles the river's valley lies from 300 to 500 or more feet below the upland in which it is cut. The width of the valley varies, but it is usually from four to five miles between the high, scenic, precipitous bluffs which bound it. The crooked river has meandered over all of this area at one time or another in its past history, and, although most of the older channels are not discernible at present, hundreds of swamps and lake-like sloughs testify as to where the stream has recently been.

The depth of the river varies from place to place and from time to time. Before improvements in the channel had been made, shifting sandbars, snags, and sawyers were a menace to navigation. The current varies from a nearly imperceptible movement in Lake Pepin to an average of about 3½ miles per hour. Navigation is usually interrupted from the middle of November to the first of April when the river is blocked with ice.

The Wisconsin upland bordering the valley of the Mississippi is dissected by a number of tributaries, the three largest of which are the Wisconsin, the Black, and the Chippewa. These empty into the main stream at Prairie du Chien, La Crosse, and at the foot of Lake Pepin respectively. The Chippewa has carried sediment to the main stream faster than that river could carry it away. The excess sediment constitutes a partial dam above which the Mississippi has expanded to form Lake Pepin.

Discovery and Early Trade

Religious enthusiasm, the desire to profit by trading with the Indians who lived in the Great Lakes and Upper Mississippi region, and the quest of discovery and adventure, early led French missionaries, traders, and coureurs-de-bois to the area now included within the boundaries of the state. The Upper Mississippi was probably first seen by Europeans in 1673 when Louis Joliet, accompanied by Father Marquette, discovered the Mississippi at Prairie du Chien after having ascended the Fox River and descended the Wisconsin. This party was soon followed by Father Hennepin who made the journey from the mouth of the Illinois River to St. Anthony Falls in 1680, being the first white man to travel all of that part of the Mississippi which now forms the western boundary of the state.

From this time of discovery until about 1830-35, fur trading was the predominating interest along the Upper Mississippi. Trading posts were established at the most advantageous places, the most important one being at Prairie du Chien where, in 1766, Jonathan Carver found a "great (Indian) trading post of 300 families". The trade with the Indians was so lucrative that the English, who gained possession of the district at the close of the French and Indian War (1763), did not surrender the western posts to the United States until thirteen years after the signing of the Treaty of Paris, and they tried to regain the territory during the War of 1812. The trade of the entire Northwest was for many years centered at Mackinaw (Michigan), but shortly after 1815 the channel of the trade changed completely, the new center being St. Louis which was more accessible and where there were several large establishments whose merchandise had been selected with special reference to this trade.

That the fur trade did little in the way of permanent settlement is evidenced by the fact that in 1800 there were only "65 souls" at Prairie du Chien and "50 souls" at Green Bay, the two largest trading posts within the area of the state. On the United States Census map showing the population of the United States in 1820, all of the Wisconsin area is blank except for two small, widely separated areas—one at the mouth of the Fox River at Green Bay, and the other at the mouth of the Wisconsin River.

Lead Mining

White men began to mine lead in the southwestern part of Wisconsin in 1827 or before. The industry grew rapidly and soon overshadowed the fur-trading. In the mining region, towns and furnaces were rapidly built. The pigs of lead were with great difficulty dragged over exceedingly poor roads to the Mississippi, and thence taken downstream to St. Louis and New Orleans. From the latter city considerable of the mineral was taken by water to New York and other eastern cities. In addition to serving as a highway for marketing the product of the mines, the river was used by the miners who spent the winters in Southern Illinois and farther south, returning to the mines in the spring. The importance of the Mississippi in connection with lead mining was made short-lived by the establishment of a quicker and cheaper route to the East by way of the Great Lakes and the Erie Canal.

Advent of the Steamboat and the Railroad

Previous to the introduction of steamboats on the Upper Mississippi all river transportation was carried on by means of canoes, rafts, flatboats, keel boats, etc. The canoes were limited in size because of the necessity of carrying them over portages. The larger ones could carry four tons, and they required a crew of eight men. Rafts and flatboats were used for downstream travel only, as a trip upstream against the current was too slow and costly. Keel boats were built to go upstream as well as down. The larger boats of this type were eighty feet long by eighteen wide. They were either cordelled

or poled upstream by men, the upstream trip being about one-tenth as fast as the downstream.

In 1823 the first steamboat made its appearance as far north as the Wisconsin area, but it was not until after 1840 that steamboat navigation assumed important proportions. Roads were few in number and those which had been constructed were almost impassable, so practically all travel was by river. Settlers coming from the east went down the Ohio, the Illinois, or Wisconsin rivers to the Mississippi, and thence upstream by steamboat. In 1841 a permanent settlement was begun at La Crosse, but prior to this year there were very few inhabitants between Prairie du Chien and St. Paul other than semi-civilized Indians, some of whom lived in villages which have subsequently grown to be flourishing cities. In 1840 the population of the Territory of Wisconsin was only 30,000, but in the next ten years this figure was increased to over 300,000. During this decade thousands of foreigners settled in counties along the Mississippi. The frontier farmer usually settled on the valley bottom where he raised small grains and some potatoes and onions. His surplus went downstream by steamboat, or flatboat, to market, and he received his supplies by river from the commercial centers to the south and east.

The rapidly increasing number of men engaged in the lumber industry, and the growing number of lumber camps and trading settlements, caused a rapid increase in the number of steamboats; in 1860 there were over 300 steamboats on the Upper Mississippi giving employment to around 15,000 men. The demand for transportation for both passengers and freight was so great that every boat was usually loaded to its capacity, and, as such a condition meant practically no competition, transportation rates were such that steamboat owners realized a big profit on their investments. Every week meant more profit, so navigation was continued as late in the season as possible. As Lake Pepin is blocked with ice about two weeks earlier than is the river above and below, all freight was unloaded at the foot of the lake and hauled by team to the river above where it was reloaded for transportation to river ports farther upstream.

As soon as railroads came into competition with the Mississippi they immediately took most of the business. In 1857 the first railroad to meet the Mississippi reached Prairie du Chien through the broad open valley of the Wisconsin River. This was just cause for excitement, for the town, being the terminus of the railroad nearest St. Paul and the upper river began to experience a lively boom. On many occasions a dozen steamboats could be seen loading merchandise from the railroad, or unloading sacks of grain and produce consigned to Chicago or Milwaukee. However, in 1859 another railroad, having La Crosse as its terminus, reached the Mississippi, and then La Crosse began to have most of the trade which Prairie du Chien had been profiting by. At the opening of the Civil War, volunteers from St. Paul and vicinity, who were going to the front, had to travel by boat to

La Crosse, whence they continued their trip by rail. In 1862 a railroad was completed to St. Paul. From this time on steamboat traffic declined rapidly, although rafting on the Mississippi and its tributaries increased at a surprising rate due to the growth in lumbering operations. At present three important roads, the Burlington Route, the Chicago, Milwaukee and St. Paul, and the Chicago and Northwestern, use the floor of the Mississippi's valley for a part of their route to the Northwest.

During the years when the commerce of western Wisconsin was controlled by steamboats very little was done in the way of improving the navigability of the rivers. It was after the decline of steamboat navigation, and when not more than twenty boats were engaged in regular traffic, that the government began (1866) to improve the upper Mississippi; but, although over

FIG. 1. LOG RAFT ON THE MISSISSIPPI RIVER AT PRAIRIE DU CHIEN.

$5,000,000 were expended between 1866 and 1876, systematic work was not undertaken until 1878. Previous to this date the larger boats during the months of low water could not proceed farther upstream than La Crosse or Winona (Minn.). By the construction of wing dams, consisting of brush mattresses weighted-down by rock, and the closing of side channels, a minimum depth of 4 feet for average water stages was obtained. Since 1907, by a further application of this kind of work, the channel depth has been increased still more, and soon there will be a minimum depth of 6 feet between St. Louis and Minneapolis. Even if these improvements do not result in increased business for the river, the potential competition will tend to keep down railroad freight rates and the annual saving to the people of western Wisconsin from this cause will be a very important item. At present the

river rates are about 66 per cent as high as rail rates; still, in 1910, there were only 1,836,030 short tons carried on the upper river.

Lumber Industry

It is in connection with this industry that the Mississippi has been most influential in aiding the development of Wisconsin. It is almost impossible to exaggerate the importance of the river and its tributaries in causing the rapid exploitation of the forests after the industry was well started. The original stand of white pine in the state is thought to have been 100,000,000,000 or more board feet. Over half of this grew in the area of the state which is drained by the Mississippi. Little did the French and English fur-

FIG. 2. HAULING LOGS IN THE LUMBER WOODS IN THE OLD DAYS.

traders realize that this enormous stand of timber was to play such an important role in the development of the state, as time has subsequently proven to be the case. Practically every city and town north of a line drawn eastward from La Crosse owes its development to the lumber industry. Some of these cities also owe their temporary stagnation or decadence to the deforestation of the area which is tributary to them.

One of the first saw-mills to be built in the state was constructed on the Black River in 1819. This mill was destroyed by fire before any sawing of importance was done. In 1831-32, a mill on the Menominee River, a tributary of the Chippewa, sawed around 100,000 feet of white pine, but about half of this was lost in the attempt to float it to St. Louis. Many difficulties

attended these early attempts, but the market price of lumber ($50 to $60 a thousand feet in 1830) was so high, and timber, to be had for practically nothing in Wisconsin, so plentiful, that considerable progress was made. As the demand from the prairie settlers to the south and southwest increased, more and more saw-mills were operated. At first only the trees near the principal streams were felled, and only the choice trees were selected. The logs were either sawed in the forests near the rivers and the lumber floated down the rivers to the Mississippi and thence to market, or they were hauled over iced roads to the rivers whence they were taken down-river to towns in Wisconsin, Illinois, Iowa, and Missouri.

The table* below tells the story of the rapid increase in the lumber industry after 1860, and the decline since 1900:

1850 about.....	$ 1,250,000	1890 about.....	$61,000,000
1860 about.....	4,500,000	1900 about.....	58,000,000
1870 about.....	15,000,000	1905 about.....	44,000,000
1880 about.....	18,000,000	1910 about.....	30,000,000

It should be remembered that the price of lumber has increased rapidly during the past twenty years and that the decline in actual amount of timber cut is greater than these figures indicate. "When lumbering was at its height, a single mill at Chippewa Falls cut 65,000,000 feet of lumber annually and one company drove down the Chippewa 400,000,000 feet in a single season."*

During all these years of lumbering prosperity, the Mississippi and its tributaries carried the logs and lumber to market, and until the timber which could be profitably hauled to the rivers had been cut, the railroads were not successful competitors for the business. The river as a carrier of forest-products is now of practically no importance—in 1913 only six small rafts passed La Crosse.

From the foregoing paragraphs it is evident that the Upper Mississippi system has been of inestimable value to the people of western Wisconsin. At present the river traffic is almost negligible, although there are still several packet-boats making regular trips between St. Louis and St. Paul, calling at river towns between. In the future, as now, the river will probably influence railroad rates, and if these become too excessive a larger percentage of bulky freight will be carried by water.

THE MAKING OF MILWAUKEE.

By L. T. Gould, Normal School, Milwaukee.

WHY was Milwaukee located just where it is? The answer to this question appears when one realizes that nature furnished at this point a net-work of conditions which made three important acts in transportation possible. First and chiefly, goods might be transferred from lake vessel to land carriage and vice-versa, with a great degree of safety. Second,

*Whitbeck: Wisconsin Geol. Survey, Bulletin XXVI.

lake craft might run in for protection in time of storm. Third and least, a vessel might lie in here for repairs and for the winter. In short here existed the essential conditions for a harbor.

To appreciate the significance of the above, it will be worth while to review the essential points of an ideal natural harbor and then to estimate the value of the Milwaukee situation by applying these standards.

The Harbor

(a) An ideal natural harbor must have quiet water. A vessel cannot transfer freight safely or economically unless it is at rest. So, a harbor implies protection, shelter from wind and wave, and these the harbor of Milwaukee provides.

The harbor around which the city has grown up is a bay, wide open on the east, having three rivers debouching through a common mouth and protected on the east by the land rising between the Bay and the rivers.

The Bay offered a quiet basin of water when the wind was not blowing from any of the three eastern quarters. From the remaining five points of the compass it was protected by the more or less elevated land. During a large per cent of the season of navigation the Bay offered the needed protection for anchorage, entrance and exit. It constituted the outer harbor.

Up the rivers lay quiet water where ships might dock and discharge or take on load. The rivers afforded an inner harbor.

(b) But quiet water must be supplemented by depth. Every vessel requires a certain number of feet draft, i. e., the vertical distance from the water line to the lower edge of the keel. A study of the first map made of the situation shows that the Bay had ample depth, for the vessels then sailing the lakes, up to within a short distance of the entrance to the river. Just outside the entrance a bar had formed, due to the wash of currents and waves in the Bay. The natural mouth had a depth of 3½ feet. Inside the entrance the depth was over 12 feet, sufficient to allow boats of considerable draft to navigate to points farther up, where docks might be constructed.

(c) An ideal harbor must have size. Many harbors have the requisite protection and depth but lack room. The amount of freight that a harbor can handle will depend partly upon the number of vessels which may be accommodated at one time. The Bay had several hundred acres of anchorage ground and the rivers had actually and potentially about 20 miles of frontage. By improving the channels, the harbor afforded ample room for developments for a century.

(d) The anchorage ground must be of such a character that it will "hold." Given a smooth rock floor or soft mud at the bottom, the flukes of an anchor will not take hold firmly. A stiff mud or clay offers the best holding ground, and this is precisely the character of the material on the floor of Milwaukee Bay.

(e) The channel through which the vessel enters the inner harbor ought to be as straight as possible. In this respect the harbor of Milwaukee

was seriously handicapped. Just inside the entrance the river turned sharply to the north, then turned and twisted for a mile or more up stream. Added to this drawback, the channel was full of weeds.

(f) There is one more important feature which promotes or retards the usefulness of a harbor, viz., a climate which gives an ice-free port the year round. In this respect the harbor of Milwaukee suffers to some extent varying with the severity of the winter.

These six conditions then, protection from wind and wave, deep water, size, anchorage ground, entrance channel, and freedom from ice combined in varying degrees of excellence, influenced the location of the port of Milwaukee. The fact that the position is on the west shore and well south toward the head of Lake Michigan is worthy of note in the interpretation of the city which follows. A fortunate location of an urban center is the first great step in its making.

But we have seen that in most of the above respects nature had not afforded a perfect work. The first great hindrance to the use of the harbor lay in the bar at the mouth of the river. This shoal spot prevented boats of more than 3 or 4 feet draft from entering. Small craft could and did use the inner harbor. Larger vessels anchored outside in the Bay and discharged and received freight by lighters. This method resulted in loss of freight and some lives, for the Bay was rough at times when the wind blew from the east. Out of this hindrance grew the first harbor problem, viz., the improvement of the river mouth.

A second handicap to shipping existed in the crooked and weedy channel. Just east of this lower course of the Milwaukee River, and running about three-quarters of a mile north of the old mouth lay a long, narrow, low strip of land which separated the Bay from the lower river. The citizens saw the possibility of completely eliminating this crooked and choked entrance channel by cutting a canal only a few rods in length across the narrow strip, 3000 feet north of the old mouth. It is the business of the federal government to improve the entrance ways to the Lake harbors. The first survey was made and the engineer agreed with the citizens that the new channel, henceforth known as the "straight cut," should be made and piers constructed. The matter was dropped by the powers at Washington for several years and the port of Milwaukee continued to suffer. Finally the matter of improvement was taken up by the government and a re-survey ordered. The new engineer reported in favor of the old mouth. The work was accomplished in due time and the folly of the improvement of the natural mouth immediately appeared. Boats attempting to make the entrance in rough weather especially when a north-east gale was on, were either driven against the outer ends of the piers, or, failing to make entrance, were driven on shore and beached. An unsuccessful effort to improve the entrance to the inner harbor was made by the government engineers and several years of time were practically wasted.

Public sentiment rose to a high pitch in demanding that a straight cut be

made across a narrow neck of land a little north of the old mouth. Finally the citizens raised funds to dig the needed channel. However the end was not yet. Later the government finished the work so audaciously begun by the citizens and lake commerce used the harbor increasingly as the years passed.

But the old troubles in the outer harbor continued when rough weather prevailed in the Bay. Out of this problem arose a third step in the making of the harbor, the construction of the breakwater. Behind this protecting wall of concrete vessels may lie in safety and those entering the inner harbor

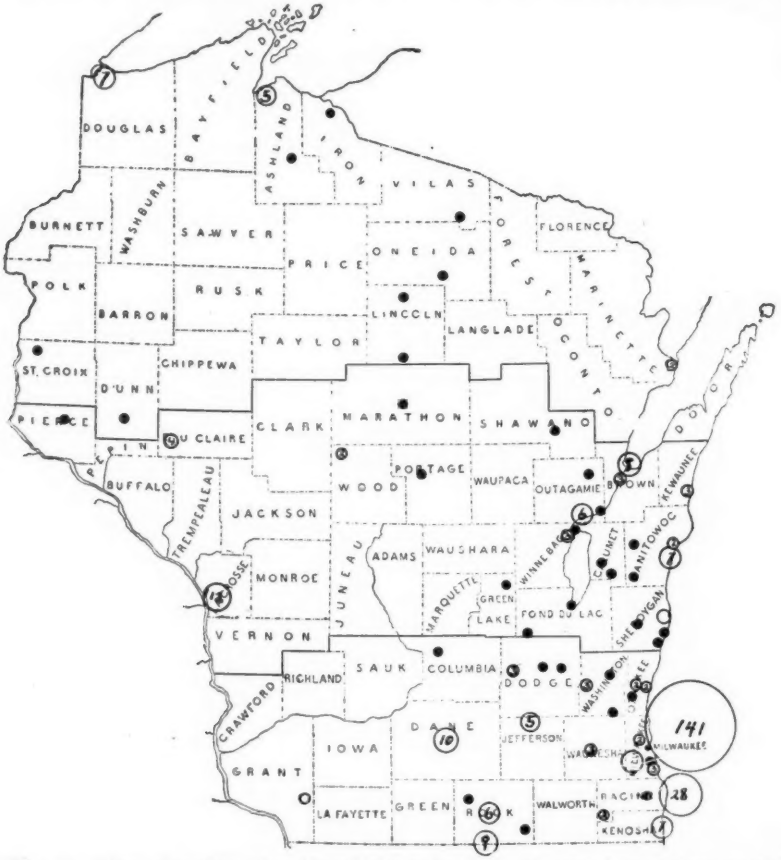

Fig. 1. Map showing the distribution in 1910 of metal working establishments employing an average of ten or more men. The number in a circle indicates the number of such establishments in that place. Note the concentration in Milwaukee.

may do so without fear of being dashed against the pier heads or beached by a rough onshore sea.

While the improvement of the outer harbor was going on the commercial interests of Milwaukee were improving the inner harbor. The deepening and extension of the channels which constitute the inner harbor has developed up to the very limits set by man and nature in the Milwaukee and Menominee rivers. Still the demand is increasing for more dock room. The next step in

the making of the harbor is the solution of this problem; where and under what system of plans may Milwaukee increase the frontage of the inner harbor?

A beginning has already been made and it is only a matter of time when the inner harbor will be in a position to care for the growing needs of the port for years to come.

But nature may furnish a harbor and man may improve it and still the port may languish. Many a fine natural harbor never thrives. Milwaukee is not merely a Lake port; it is a port of great importance. It has a population of nearly 400,000 inhabitants and is one of the industrial giants. ***What caused Milwaukee to grow?*** One must reckon with other geographical factors than the harbor in order to understand this fact of size.

The Hinterland of Milwaukee

The most important physical factor in the growth of a port is its hinterland. West, northwest, southwest, yes, even to the north and south of Milwaukee lies its tributary district. From and to this area, difficult to delimit but certain in fact, the port pumps sustenance. Southern Wisconsin and Minnesota together with the Dakotas and northern Iowa is a rich section of the prairie plains. This rolling expanse of glaciated soil is an agricultural district par excellence. The Dakotas and Minnesota produce spring wheat as a specialized crop, Southern Wisconsin and Iowa fall in the corn belt. Corn means live stock, so does the grass and hay belt of Wisconsin. The conifer forest and the mixed forest of the Great Lake district lies to the north. The lead district of the southwest corner of the state and the iron ranges of the Superior district are within Milwaukee's commercial radius. The hinterland is wide and deep, it is rich to overflowing, and its products are varied. The resident population has developed these resources.

Ease of Transportation

But if the character of the tributary district conditions the growth of the port, it is almost as essential that the natural pathways leading thereto, afford easy connections between port and region.

So easy of access is Milwaukee by both wagon and railroads across the plain that the land routes radiating outward have encountered barriers of but slight consequence. The Blue Mound and the Watertown Plank roads penetrated the district to the west of the city. Over these, lead came hauled by team from the Lead District. The Fond du Lac road ran to the northwest and the Green Bay trail to the north. The fairly level lay of the land gave easy grades and straight lines from point to point. To be sure, rivers had to be bridged, hills cut and swamps filled, but on the whole, the road problem was favored highly by the lay of the land.

Two railways dominate the situation—the C. M. & St. P. and the C. & N. W. Both tap our state to the west and the southwest, both cross the Mississippi and penetrate the wheat, corn and live-stock district beyond. Both own routes to the northwest and both enter Northern Wisconsin and

Michigan territory with its timber and wood products, ore, and agricultural output. The old Wisconsin Central line, now the "Soo", serves a strip through the state from north to south. It runs into Milwaukee over the Saint Paul tracks. Both of the first named roads connect Milwaukee with Chicago. Nine distinct lines of roadbed join the port of Milwaukee with its tributary district.

As each of these lines approach the port from the outlying prairie it drops by easy grades down to the level of the harbor.

The "Foreland" of Milwaukee

Turning now to the foreland, if one may be allowed the expression, what natural and human conditions are found which bear upon the making of our port? Down in the folds of the Appalachian Mountains in eastern Pennsylvania is coal, the best hard coal in the world. Further west in the Allegheny Plateau is soft coal, the best soft coal in the United States and plenty of it. A short haul by rail connects these fields with Lake Erie. Away to the east lie the manufacturing districts of New England and the Middle States. Between Milwaukee and the fuel and manufactured goods of the east stretches nearly 1000 miles of unbroken inland waters. Add to this lake-waterway the flat land south of Lake Ontario, the Mohawk gap and the Hudson valley, and one realizes the great natural pathway which constitutes another asset in the prosperity of Milwaukee.

These features of harbor, hinterland and foreland must be put together item by item, to get a complete view of so complex a thing as a large industrial port. But the synthesis of a few of the most important items will be sufficient to illustrate a method of organizing the material.

Milwaukee as a Market

As soon as the farmers in the vicinity of Milwaukee began to produce a surplus grain crop (wheat at first) the port began to receive grain and to ship it eastward by lake. A lake schooner loaded "by hand" from a warehouse was the typical method. With the gradual advance of the railway into the grain fields the grain receipts and shipments grew, and grew rapidly. By 1912 there were five public elevators all located in the harbor, transferring grain from rail to water or from rail to rail. Milwaukee is one of the ten principal primary grain markets of the central west. The cereals handled include wheat, corn, oats, barley and rye. Besides the five public elevators there are many smaller ones owned by brewers, maltsters and millers. The receipts of grain in 1912 were nearly 51 million bushels. Over 13½ million bushels were shipped eastward by lake. More than 14 million bushels were forwarded by rail while 23 million bushels remained in the city. Of all the freight which enters Milwaukee by rail 31 per cent is raw grain. Besides the grain, there is a heavy tonnage of flour and malt which comes by rail. If these grain products are added to the above 51 million bushels the figures swell to 65 1-3 million bushels grain receipts in 1912. The manufacture of malt and the beer for which the city is so infamously famous, attracts

barley to such an extent that Milwaukee is the chief barley market in the United States.

From the corn belt and the grass and hay districts of the hinterland arrive shipments of live-stock at the stock yards in the Menomonee valley. The receipts of live-stock in 1912 included over one million hogs, 108 thousand beef cattle, 60 thousand sheep and 102 thousand calves. Over 10 million pounds of wool were received but 90 per cent of it passed through to the east via the Lakes.

Tobacco from Dane, Rock and other counties came to Milwaukee in 1912, to the extent of over 6½ million pounds. Over two-thirds of it remained in the city.

Most of the raw material of the forest shipped to Milwaukee comes by rail. The lumber cut is so removed from points handy to Lake shipments that the old time lumber schooner is bringing less and less lumber into port. Most of the yards are still located at the water's edge in spite of the fact that but little use is made of the docks. In 1912 the receipts show a heavy tonnage of incoming lumber, about 278 million feet. Nearly one-third of this was reshipped in various directions. Shingles, over 85 million; lath, over 40 million feet, and of cedar posts about 621 thousand.

Iron ore from Escanaba and other ports of the Lake Superior iron ranges is shipped in mainly by lake. The tonnage is not large. Only 145 thousand tons were received in 1912. In order to explain the chief manufacturing industry of Milwaukee, viz., heavy iron and machinery products one has to look elsewhere than to the local furnaces which reduce iron ore.

Turning now to the east, a most conspicuous factor in Milwaukee's growth reveals itself in the tonnage of hard and soft coal arriving by lake. The coal shipping ports of the south shore of Lake Erie pour coal into the harbor from the opening of navigation to its close, a period of 7 months, or more. Ninety-four per cent of the coal receipts are by lake. Twenty-seven coal yards with docks equipped with modern coal unloading machinery receive the largest lake freighters and transfer nearly 5¼ million tons per annum, (1912) from lake vessels to coal piles and bins. Coal receiving and distributing is the largest single factor in the work of the harbor. Fifty per cent of the coal which enters remains in the city. The remaining fifty per cent is distributed to the hinterland. At present Milwaukee is listed at the head of the coal-receiving Lake ports in tonnage received by Lake.

The next most important function of the harbor after the handling of coal is the loading and unloading of manufactured and partly manufactured goods. The miscellaneous and package freight from the east and also from the south is closely related to Milwaukee's growth for upon these depend not only the consumer of the completed article but the manufacturer or builder who uses them. Many of the eastern railways run package freight boats from Buffalo, Erie, or Oswego to cities at the head of the upper lakes. The car ferries plying between Milwaukee and Ludington and Grand

Haven participate in this traffic also; likewise, the lines operating north and south on Lake Michigan. This assembling of the staple raw and semi-raw materials; grain, live-stock, lumber, iron, etc., plus coal for power, heating and lighting, plus the facilities for the break in transportation, combine to form a firm basis for manufacturing activities. It is the factories which are most immediately responsible for the massing of nearly four hundred thousand people in the Milwaukee area. It is the values added to the raw material by manufacturing which explains in part the general prosperity of the people.

Fig. 2. Map showing the larger tanneries of Wisconsin. Milwaukee is the leading center of the United States.

Manufacturing

Where grain is transferred and stored there springs up a possibility of flour-milling. But mills need power. The cheap soft coal at hand solves the problem. Add to accessible grain and power a populous district of flour consumers and the mills may operate profitably. The output for 1912 was over one million barrels.

Another line of grain manufactures sprang up in the malting and brew-

ing industries. Milwaukee supplies nearly one-fourth of the malt in the United States.

Of beer Milwaukee brewed considerably over four million barrels in 1912, a larger amount than in any preceding year. The location of this industry is again partly due to proximity to grain, power, and market.

Out of the available live stock, power and transportation facilities arises the packing industry, though other factors assist. The number of hogs packed in 1912, 1,036,507, indicates that practically all the live-stock entering the city is slaughtered here.

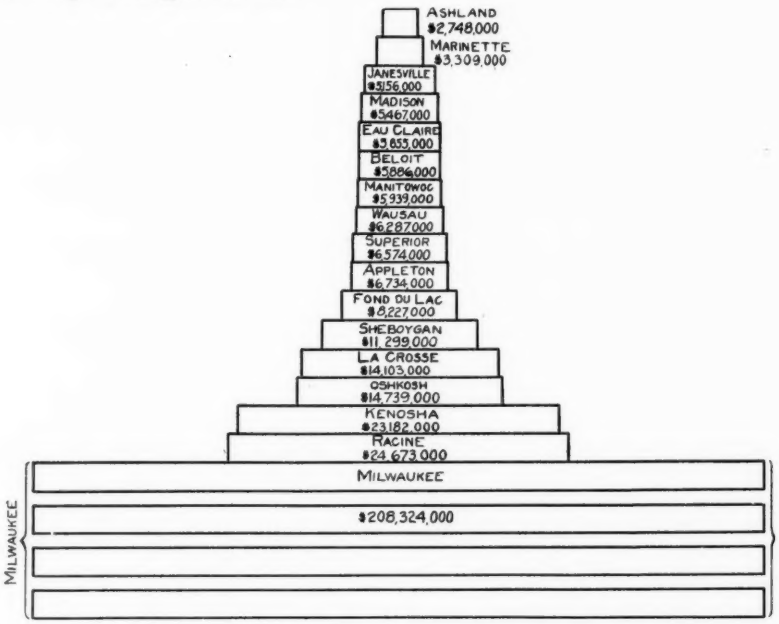

Fig. 3. Diagram showing value of manufactures produced in cities of 10,000 or more people, U. S. census of 1910. Milwaukee's output exceeds that of all the other cities combined.

The milling, malting, brewing and meat packing industries form a considerable proportion of the city's manufacturing output. There are 23 establishments with a product valued at nearly sixty-five million dollars in 1912, approximately one-sixth of the entire output of all factories.

The manufacture of iron, steel and heavy machinery is the largest industry if wages paid, men employed, and value of product are taken as standards of measurement. In 1912 out of one hundred and nineteen thousand employes, seventeen thousand or about 14 per cent were engaged in the iron industries. The geographical factors which contribute to their result are, proximity to iron ore, and to the smelters at South Chicago, Gary, Ind., and Joliet, Ill., cheap fuel, (coke), and a central position in a machine-using area.

The manufactures of leather and of boots and shoes employ over ten thousand workers. The yearly wages paid, run up to nearly six and one-half

million dollars and the value of the output reaches twenty-nine million dollars.

The tanneries are the largest in the United States, and are reputed far and wide for quality as well as quantity of output. The location and growth of this industry is explained partly by the nearness to hides, i. e., packing houses of the West, especially at Chicago and Milwaukee, the short distance to the hemlock bark of Michigan and Wisconsin by water, and partly by the skilled German tanners who early established the business.

A report published in the Milwaukee Sentinel, January 1, 1914, shows that during 1913 the factories employed over 130,000 workers, who received over $82,000,000 in wages for producing goods whose final value was estimated at more than $420,000,000.

These representative industries are taken from a list of 85 lines of manufacturing located at the port of Milwaukee. A resume of the manufacture of agricultural implements, electric and telephone supplies, coal products, railroad equipment, cigars and tobacco, hosiery and knit goods, millinery and straw-goods, etc., would only further repeat the evidence of the facts and causes of the city's growth.

Milwaukee's material prosperity depends upon her factories and her commerce. These in turn depend upon the harbor conditions, the nature of the hinterland, the region to the east and the routes radiating in all directions from the port.

SCENE IN MANITOWOC HARBOR.

THE PORT OF SUPERIOR

By J. A. Merrill, Normal School, Superior.

Location

THE St. Lawrence River penetrates the continent of North America a distance of 2000 miles. Most of the river lies between parallels of the 40° to 47° N. latitude and the head of Lake Superior lies in longitude 92° west and latitude 47° north. The river is navigable for ocean steamers, drawing 14

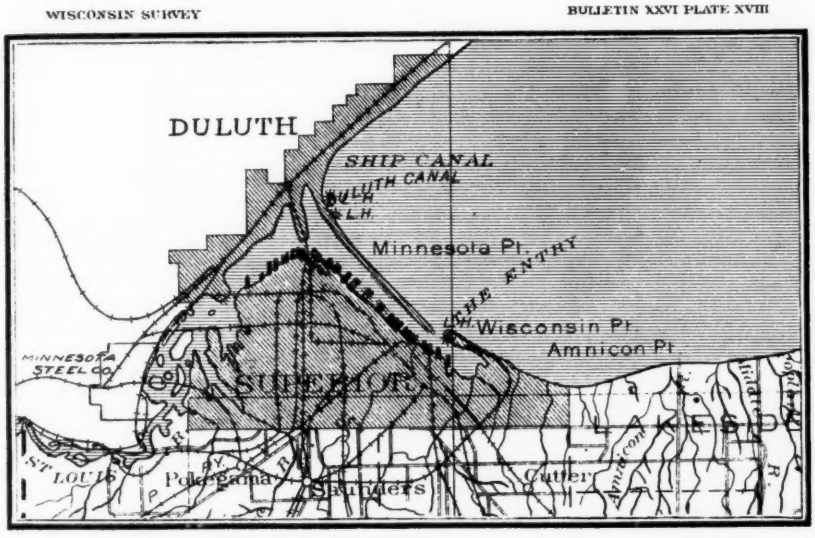

FIG. 1. MAP OF THE DULUTH-SUPERIOR REGION.

feet of water, to the head of Lake Superior. The rapids of the St. Lawrence, the falls of Niagara, and the Sault Ste. Marie rapids, are avoided by canals.

At the head of Lake Superior is found the city of Superior. It is situated on the land locked harbor of Superior Bay, the city limits extending up the river a distance of about twenty miles.

The Harbor

The harbor at the head of Lake Superior is an unusual one. In structure it is very simple, but its size and completeness make it the most remark-

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Editor's Note.—*At the head of Lake Superior are two cities with one harbor. The commercial interests of Duluth and Superior are closely interwoven and both owe their growth and prosperity very largely to the commercial strategy of the position which they have in common. Only for an arbitrary state boundary they would have formed one city. Since the Journal of Geography is devoting this issue entirely to Wisconsin, the city of Superior has been treated by the writer of the following article as if it were quite unconnected with the larger city of the pair. It is recognized that much of what is here said of the advantageous position of Superior and of the cause of its growth is also true of Duluth.*

able harbor on the Great Lakes, and perhaps the most perfect fresh water harbor in the world.

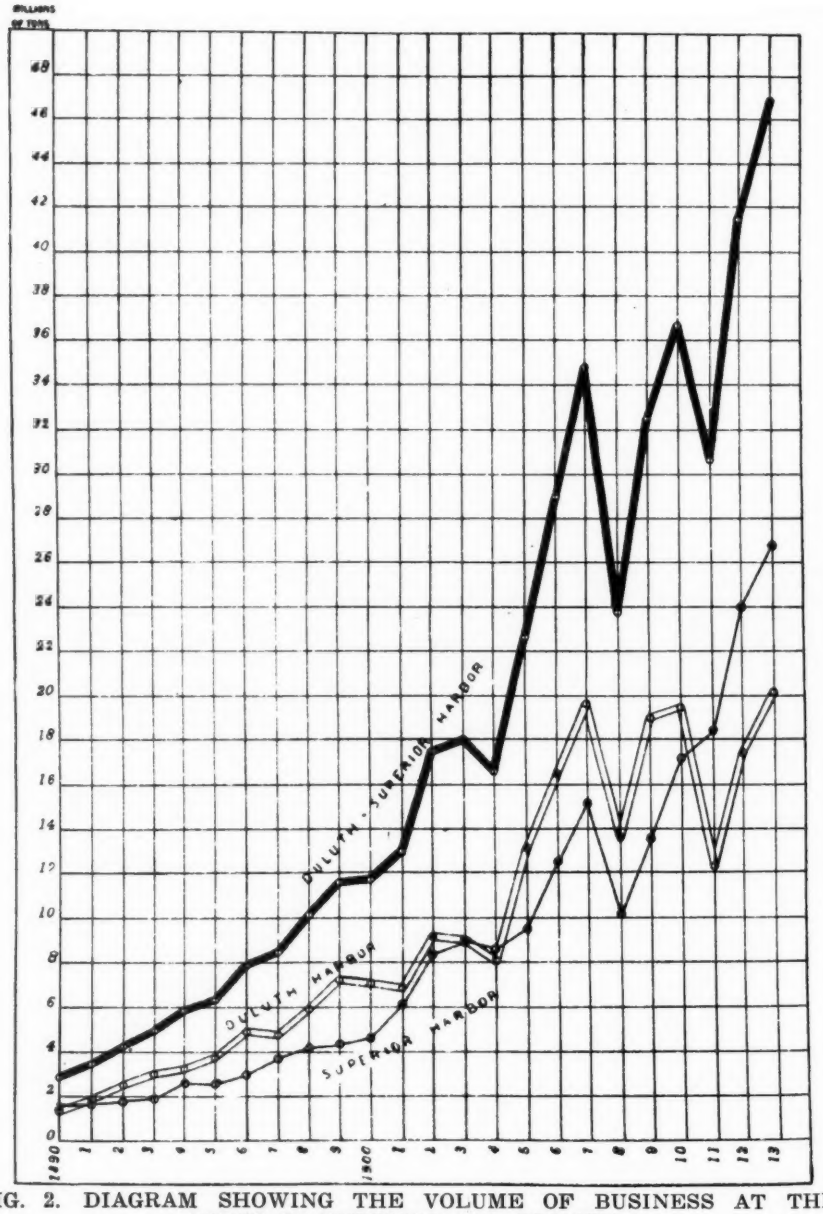

FIG. 2. DIAGRAM SHOWING THE VOLUME OF BUSINESS AT THE PORTS OF SUPERIOR AND DULUTH.

During the glacial period the lake filled all of the depression, but on the retreat of the glacier and the building up of the land at the west end of the lake, the water subsided, leaving a coastal plain twelve to twenty miles in width, on the south side of the lake. The west end of this depression, now

entirely out of the water, is occupied by the St. Louis River which comes down from the Vermilion and Mesabi Iron Ranges on the north and empties into Lake Superior at the city of Superior.

The high wall of rock on the north side of Lake Superior, together with certain climatic factors gives the head of the lakes a northeast wind during the stormy months of spring and autumn. This coincidence and the fact that the lake is deeper on the north side, produces waves of great height there, causing at times a rise in the lake level of fifteen to twenty inches. It is not strange, therefore, that these conditions should produce pronounced sandbars at the mouth of St. Louis River. These sand bars are an effective break-water against the storm waves of the lake. Since the land is very slowly subsiding, (six inches a century) a number of estuaries have been formed which increase the length of the harbor of Superior to more than thirty miles.

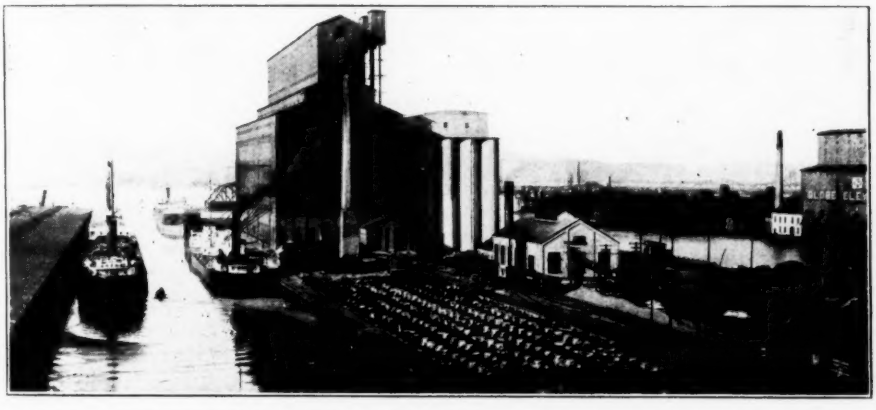

FIG. 3. GREAT NORTHERN ELEVATOR AND MERCHANDISE DOCKS, SUPERIOR. THE ELEVATOR HOLDS 5½ MILLION BUSHELS OF GRAIN.

While the sandbars are formed by nature, there still remains considerable work to prepare for the dockage of vessels of deep draft and large tonnage. In 1867 the United States Government began a survey of the harbor for the purpose of making much needed improvements. Since that time appropriations have been made regularly and improvements have been carried on continuously. The main channels in the harbor have been dredged to accommodate boats drawing twenty feet of water, the entry to the lake has been widened to one thousand feet and protected with concrete walls and ample break-waters.

Natural Advantages of the City

It is evident that Superior has all of the advantages that come with a fine harbor and a great waterway. But this alone can never make a city since many of the best harbors are situated in places where they can never benefit humanity. A harbor is a meeting place of "sail and rail" and its value depends upon the fact that it provides terminal facilities for water traffic and

greatly reduces the cost of transportation. It is estimated that the general reduction in freight rates between Superior and New York is such that the average cost by lake and canal is less than one-third of what it would be by rail.

The value of the harbor to the city of Superior depends upon the following conditions:

1. *The number of people supported.* The commerce transacted in Superior is the result of the activities of about seven millions of people living to the westward, and engaged in developing a very large territory of grain fields and ore lands; and about the same number of people living in or near the coal fields in the eastern part of the country, and engaged in mining and manufacturing.

2. *The vast deposits of coal in Ohio, West Virginia, and Pennsylvania near Lake Erie, and the absence of coal deposits in the area west and southwest of Lake Superior.* It is possible to deliver coal more cheaply to Superior than to Chicago and hence most of the coal used north of the line drawn from Superior to Omaha is delivered through this port and about seventy per cent of it is delivered from the docks in Superior. On account of the fact that navigation is closed about four months of the year, large storage docks are necessary, and it is said that this city has the largest storage capacity for coal in the world.

3. *The large deposits of high grade iron in Minnesota near Superior which is necessary in the manufacture of iron and steel in the Pittsburg district.* These deposits are the largest and richest known. There are three systems of docks in Superior for handling this ore.

4. *The large grain fields in Minnesota, the Dakotas and the Canadian Northwest, the surplus of which must be shipped to the eastern states and to foreign countries.* Superior is the most convenient terminal for this area and hence very large elevators and mills are located here.

5. *A water power plant with a capacity of* 150,000 *horse power,* located within 10 miles of the city limits, furnishes abundance of cheap power for the city.

6. *The large general freight business that is transacted at this point.* Various kinds of raw material, food products and manufactured goods are shipped here from the east and distributed westward. About 39,000 miles of railroad radiate from Superior to the territory which it serves. From the west come large quantities of wool and copper, lumber from the Pacific coast, grain of all kinds, flour from Minneapolis, and many other articles, to be shipped eastward.

7. *A large area of comparatively level coastal plain, suitable for manufacturing sites and for railroad terminals.* There are six railroads entering the city, three of which have extensive terminals here. There are in the city 182 miles of railroad tracks used as terminals by the railroad lines.

8. *In the immediate vicinity of the city there is a considerable area of*

very fine farming land, suitable for general farming and dairying. This land is rapidly being put under cultivation.

Industrial History

The white man came to Superior and found an Indian Village on Wisconsin Point. The appearance of the harbor was so attractive that people flocked to the new port from many parts of the United States. Without consideration as to the surrounding country, these people thought that the perfect harbor would soon develop a large city. The city of Superior, therefore has had three distinct periods of growth:

1. The first period resulted from the discovery of the beautiful land-locked harbor and the general belief that a great city would rise here. There were no industries in the city and no farming around it, so naturally the first attempt at building a city failed, and the population declined.

2. The period of railroad building. The St. Paul & Duluth, now the

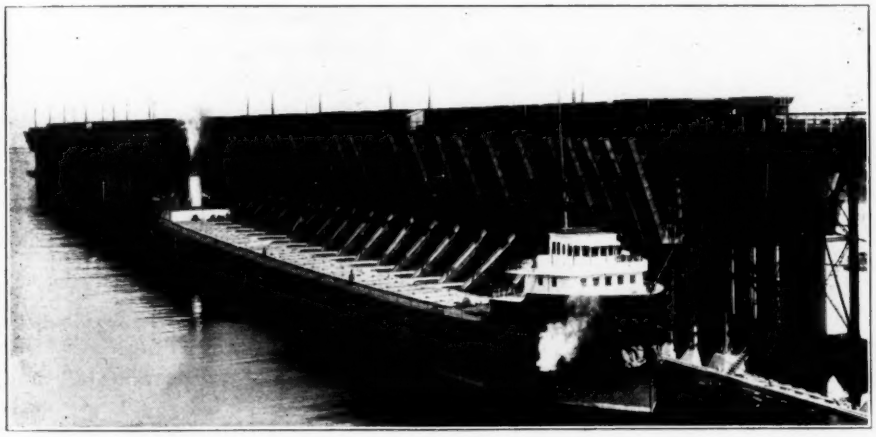

FIG. 4. GREAT NORTHERN ORE DOCKS, CONSTRUCTED OF STEEL.

Northern Pacific Railroad, was built to the head of the lake in 1869, but was prevented from benefitting Superior by the terms of its charter which provided that its terminal should be in Minnesota.

Other roads followed, the Great Northern in 1888, the North-Western in 1882, both of which had their terminals in Superior. Both of these roads built extensive docks and elevators and prepared to take care of the immense trade that bade fair to come in from the developing of the Northwest. Industries flocked to the city, flour mills were built, a large steel plant, a wagon factory, a ship-building plant, and many other factories were located here and the city seemed to be entering on a period of permanent prosperity. This port, being a natural break in transportation, seemed the logical place for these industries and the population increased rapidly.

About this time, however, in 1893, a rate decision was handed down by the Interstate Commerce Commission and accepted by the railroads, giving

a better rate eastward to Minneapolis and St. Paul than to Superior, so that it became impossible to manufacture at this point flour, steel, or any other article that was affected by the rates. This is an illustration of how freight rates can make or kill a city. These rates were allowed presumably because Superior was not adequately represented at the meeting. A few of the manufacturing plants survived, but most of them succumbed and were absorbed by competing plants in Minneapolis and Cleveland and were locked up after the manner of trusts and monopolies.

This decision was given in 1893, and its effect on this young city was immediate and destructive. A period of depression set in. However, even during the depression, the business of the port increased. Docks were constructed or enlarged, railroad terminals were being increased, elevators were being built to care for the constantly increasing business which was being managed from other cities. This fact alone kept a considerable air of prosperity about the city, even though business initiative in the city itself was at a standstill.

3. The new era now dawning. This dates from a new rate decision by the Interstate Commerce Commission in which Superior is given the same rates to and from the east as Chicago on ordinary and package freight. The rate on bulk freight is lower already. This makes it possible for manufacturing plants to locate here and conduct their business at a profit, giving to this city the benefits of its location at the head of the Great Lakes.

In anticipation of this decision and since its announcement, manufacturing has shown a large increase. The plants located here have increased their capacity and many others are securing sites.

The Present Condition of the City

At the present time Superior has a population of between 40,000 and 50,000. The principal industries, i. e., those that employ most men, are those connected with the docks and railroads. Some idea of the magnitude of this work may be obtained from the following statements:

1. *Coal Docks.* There are 16 coal docks in the city. These docks receive the coal that comes up the lakes during the season of navigation and ship it out, mostly in the autumn and winter to consumers west and southwest. The storage capacity of all of these docks is more than 8,000,000 tons. The boats carry in one cargo from 8,000 to 12,000 tons and are unloaded in from one to two days. The boats are unloaded with shells or buckets that take from the boats 5 to 13 tons at one time. These coal docks give employment to over 1500 men and spend annually in the city for labor and materials over $3,500,000.

2. *The Ore Docks.* There are three systems of ore docks in the city. The largest one, the Great Northern, handles ore from the Mesabi Iron Range while the other two, recently built, handle ore from the Cuyuna Range. The Great Northern system of docks consists of four docks which have a storage capacity of 428,000 tons of iron ore. During the past season

there was shipped from this dock 16,500,000 tons of iron ore. This system is said to be the largest ore dock system in existence; during the shipping season it employs 575 men and pays out for labor and materials in the city, over $297,000 annually.

3. *The Elevators.* There are 16 grain elevators in the city. The largest of these, shown in the cut, has a storage capacity of five and one-half millions of bushels. From this elevator during the last season was shipped forty-one million bushels of grain, about twenty-five millions of which was wheat. During the last shipping season all of the elevators in the city shipped eighty-six million bushels of grain, two-thirds of which was wheat.

4. *The Flour Mills.* These are two in number under one management. When running at full capacity, which they have been doing for the past year, they have an output of 75,000 barrels of flour per month.

5. *Other Important Factories.* A linseed oil mill makes about 10,000 gallons of linseed oil daily, using about 4,000 bushels of flax seed.

There are a number of other important factories in the city, the largest of which are the Webster Chair Factory, employing 350 men and producing an output of 1200 chairs daily, and the Duplex Works employing 120 men with a large output of engines and windmills.

6. *Important Property of the City.* In addition to an adequate and commodious municipal building the city has more than 1000 acres of land for parks, including one mile of dock property, a large proportion of which is unimproved. It has also very valuable land, about a hundred acres, on Superior Bay front to be used for city docks. This is a larger harbor frontage than is owned by any other city on the Great Lakes.

Volume of Business

By reference to the diagram, Fig. 2, it is seen that the volume of business has increased enormously, though with some variation, since the opening of the port. This has taken place in spite of the fact that freight rates, in a way, have discriminated against the city. It is evident, furthermore that the great volume of business will in time reduce the rates still more. Below is given in tabular form the comparative tonnage and value of several of the world's greatest ports.

City	Entered and Cleared in 1911: tons.
Liverpool	14,767,990
London	20,978,221
Hamburg	23,776,188
Antwerp	26,556,000
New York	27,854,255
Superior (in 1912)	23,990,860

The reader will quickly realize that the *value* of the freight handled at the other ports compared with Superior is vastly greater, inasmuch as they are in densely populated districts and the freight is largely manufactured

goods or raw material that has great intrinsic value; nevertheless the comparison is significant in pointing to the future of this port when the surrounding region is more fully developed.

The Future of Superior

It is not beyond the purpose of this article to give a few points about the future of this port. The volume of business has grown up without reference to the demands of the city itself, but since the city is now entering a manufacturing stage it is clear that the growth of business and wealth as well as population will increase faster than in the past. The factors that will figure most largely in the future of Superior aside from the ones mentioned heretofore are the following:

1. The Welland Canal. This canal around Niagara Falls is being enlarged and deepened so that it will accommodate ocean steamers and will permit vessels of large size to clear from Superior to any port in the world. This will make this an ocean port.

2. The Erie Barge Canal. This canal from Buffalo to New York City is being enlarged so that it will easily transport 75,000,000 tons per annum as compared with 3,000,000 tons, its present tonnage. This waterway of the Great Lakes-Erie Canal will then be able successfully to compete with the Panama Canal from the west coast to New York and intermediate points.

3. The Manufacture of Steel. Across the St. Louis river, on the Minnesota side, the U. S. Steel Corporation is erecting a mammoth steel plant, which promises to be, when completed, equal to the one at Gary, Indiana. Considerable land is owned by this corporation in the city of Superior and it is expected that much of the plant will be in this city. Furthermore, if this city becomes a primary steel market, which is now expected, other steel plants will be erected here to meet the demands for steel in the West and Southwest. It is also expected that the tariff adjustment will be such that much iron and steel will be made for the Canadian trade.

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tion to Agriculture, University of Wis., Agricultural Experiment Station, Bull. 223.

Bulletins of State Geological and Natural History Survey may be obtained from the State Geologist, Madison, Wis., at the prices indicated. Some of the publications are out of print, but are usually to be found in public libraries.

Bulletins of the Survey are sent to schools at time of publication. Additional copies may usually be secured by addressing Supt. of Public Property, Madison.

There are other bulletins on Clay, Building Stones, Forests, etc.

MAPS, ETC.

1. Geological Map of Wisconsin, 1912, 54 by 62 inches. May be obtained from the Supt. of Public Property, State Capitol, Madison, Wis., at a cost of $1.00.
2. Hydrographic maps of the principal lakes of southern and southeastern Wisconsin. May be obtained from W. O. Hotchkiss, State Geologist, at a cost of ten cents each.
3. United States Geological Survey topographic maps. Scale generally one mile to the inch. May be obtained from the Director, United States Geological Survey, Washington, D. C., at a cost of 10 cents each. These are very detailed maps each covering an area about 13 by 18 miles in extent. The maps thus far issued include the regions surrounding the following named places:

Baraboo
Bayview
Briggsville
Brodhead
Cross Plains
Delavan
Denzer
Eagle
Elkader
Evansville
Fond du Lac
Geneva-Racine
Hartford
Iron River (Mich.-Wis.)
Janesville
Koshkonong
Lake Geneva
Lancaster (Wis., Ia., Ill.)
Madison
Marathon special
Milwaukee
Milwaukee special
Mineral Point
Muskego
Neenah
Oconomowoc
Portage
Port Washington
Poynette
Racine
Richland Center
St. Croix Dalles (Wis. Minn.)
Shopiere
Silver Lake
Sparta
Stoughton
Sun Prairie
The Dells
Waterloo
Watertown
Waukesha
Waukegan (Ill. Wis.)
Waukon (Ia. Wis.)
Wausau special
West Bend
Whitewater
Winnebago special

4. Charts of Lakes Michigan and Superior, and harbor maps of Superior, Ashland, Green Bay, Sheboygan, etc. To be purchased from U. S. Lake Survey Office, Detroit, Mich., at a cost of from five to thirty cents.

5. Mississippi River charts, La Crosse, Prescott, etc., Mississippi River Commission, St. Louis, Mo. Cost 26 cents each.
6. Model of Wisconsin, Form showing topography alone, $31.00. Form showing topography and geology, $46.00. To be obtained from W. O. Hotchkiss, State Geologist, Madison, Wis.

STATE SOIL SURVEY.

The Soil Survey is engaged in preparing maps showing the soils of the state as follows:

General maps of the northern portion and detailed maps in the southern and older section. The general maps will be five in number, two of which have already been prepared by Dr. Weidman; one including Portage, Taylor, Wood, Clark, Marathon, Lincoln, southern Price, and western Langlade counties. The edition of this report is exhausted, though maps may be secured of the state geological survey, Madison, Wisconsin. The second, including Polk, Barron, Rusk, Chippewa, Eau Claire, Dunn, Pepin, Pierce, and St. Croix counties can be secured by addressing the undersigned. The third, including Burnett, Washburn, Sawyer, Bayfield, and all but the southeastern part of Ashland, is in preparation and is expected to be ready for distribution in 1915. The work of the fourth area, including Forest, Florence, Langlade, Oconto, Shawano, and Marinette counties has been completed and the analytical work is now being done and it is hoped that the map and report on this area will be ready for distribution early next winter. Reports on Marinette County are now available. A part of the field work of the fifth area, including Iron, Price, Vilas, Oneida, and the southeastern part of Ashland counties has been completed and the remainder of it will be finished during the coming season and the report should be ready for distribution during the early summer of 1915.

In the southern older section of the state the reports are being made on individual counties. Those on Waushara, Iowa, Waukesha, and the Bayfield Peninsula are now in press and will be ready for distribution the latter part of 1914. Fond du Lac, La Crosse, Juneau, and Kewaunee counties have been surveyed and the reports should be ready for distribution during the latter part of the summer of 1914. The field work on Columbia, Jefferson, Dane, and Buffalo counties has also been completed, but the reports cannot be issued before 1915. (These county soil maps may be secured by writing to your member of Congress.)

There is no general map of the soils of the state, though it is expected that one will be prepared as soon as the field work of the Soil Survey has been completed. Those seeking such information regarding any particular tract should address the undersigned.

A. R. Whitson, Madison, in Charge of Soil Survey.

RELIEF MAP OF WISCONSIN.
Made by Geological and Natural History Survey.